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Name of Work: **Construction of a Centre of Excellence in Healthcare R & D Facility - Includes Super-Specialty Hospital, PG Medical & Allied Education and Ancillary Facilities at IIT Guwahati campus of Assam Government-IITG Healthcare Foundation (AGIHF) on EPC Mode-III.**

Sub Head: Construction of **410 bed** Super-Specialty Hospital Block (G+6), Academic cum R&D Block (G+4), 3 BHK Faculty Residences (G+6), 2 BHK Faculty Residences (G+6), Nursing Hostel (G+9), Guest House cum Residents' Hostel (G+7), Service blocks & Gate houses, boundary walls and other miscellaneous works including Internal Water Supply, Sanitary Installations and drainage, Development works like UG Sumps, Terrace water Tanks, Water Treatment Plant, Sewage Treatment Plant, Effluent Treatment Plant, Rain Water Harvesting System, Internal Roads, Pathways, Parking facilities, Filtered and Unfiltered Water Supply Lines, Storm Water Drains, External Sewerage System, Service Trenches, landscaping Horticulture works, Electrical Installations, Fire Alarm System, Firefighting system, Lifts, Sub-station, DG sets, UPS, HVAC System, IBMS system, Solar water Heating System, Roof top solar plant, CCTV, LAN, IP based EPABX System, Audio Visual System, MGPS, Nurse Call System, External and Internal Signages etc. (more specifically written in the detailed scope of work & GFC drawings) and their integration, making fit for occupation, Providing /Fixing Furniture items etc. all complete on Engineering, Procurement and Construction basis (EPC Mode-III).

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Construction of a Centre of Excellence in Healthcare R & D Facility - Includes Super-Specialty Hospital, PG Medical & Allied Education and Ancillary Facilities at IIT Guwahati campus of Assam Government-IITG Healthcare Foundation (AGIHF) on EPC Mode-III.

PART- B

SUB- HEAD : DETAILED SCOPE OF WORK, PARTICULAR SPECIFICATIONS, SCHEDULE OF ITEMS & LIST OF APPROVED MAKES FOR –

- A. STRUCTURE WORKS**
- B. CIVIL WORKS**
- C. EXTERNAL DEVELOPMENT WORKS**
- D. SIGNAGE**
- E. HORTICULTURE**
- F. FURNITURE**

DETAILED SCOPE OF WORKS– STRUCTURE & CIVIL WORKS

S.No.	Item	Description of Item
1.00		STRUCTURAL WORKS
1.01	Disposal of earth	Surplus excavated earth shall be disposed of by the contractor after remittance of due royalty to concerned authority, as applicable, by the contractor.
1.02	Earth Filling	Filling available earth or earth / sand brought from outside shall be done as per requirement to level the ground as per GFC drawings.
1.03	Plinth filling	Plinth filling shall be done as per the recommendation of the soil investigation report or with earth suitable for plinth filling including filling of sand of grading zone IV or V as per CPWD specifications and thickness as per drawing.
1.04	Soil stabilization	Appropriate ground improvement or soil stabilization measures as per the soil investigation report and structural design, if any recommended shall be carried out.
1.05	Structure	RCC framed structure with foundation system Including Boring RCC piles, casting RCC piles with reinforcement, pile caps, Rafts, isolated footing / combined footing /, RCC shear walls, columns, slabs, beams and as per structural design / GFC drawings. conforming to relevant Indian Standard Codes shall be provided.
1.06	Anti-termite treatment	Anti-termite treatment of ground / plinth and around buildings shall be carried out as per relevant Indian standard codes/ CPWD specifications.
1.07	Grade Slab	Structural / Non- Structural Grade slab as per the necessity at site / design requirement and as per the functional requirement of supported flooring shall be designed & provided accordingly.
1.08	DPC	Damp proof course shall be provided wherever required as per CPWD specification.
1.09	Tanks / sumps	Underground structure / water retaining structure in Service block shall be part of superstructure and integrated with foundation system with suitable water proofing system and measures for collection, pumping and disposal of any water.
1.10	Grades of concrete	Grades of design mix concrete shall be used for RCC work as specified as per GFC drawings.
1.11	Reinforcement grade	Minimum Fe-550 D grade low alloy steel as per provisions contained in Note-3 of Para 4.2 of amendment number 3 to IS 1786 shall be used in the work.
1.12	Testing of piles	Testing of piles – Initial test, routine test and Integrity test as per IS Code
1.13	Piles	Dismantling / Breaking top portion of concrete piles up to pile cut off level and removing rubbish/spoil with all lifts, cleaning top portion of pile cleaning reinforcement exposed due to breaking of pile top, bending pile reinforcement into pile cap as per drawing and instruction of engineer-in-charge.
1.14	HDPE Membrane	Providing HDPE membrane 0.8 mm thick below pcc of pile caps/ grade slab.

S.No.	Item	Description of Item
1.15	Plinth protection	Drainage and Plinth protection along the perimeter of the buildings shall be provided as per GFC drawings.
1.16	Piles	Dismantling / Breaking top portion of concrete piles up to pile cut off level and removing rubbish/spoil with all lifts, cleaning top portion of pile cleaning reinforcement exposed due to breaking of pile top, bending pile reinforcement into pile cap as per drawing and instruction of engineer-in-charge.
2.00		SEISMIC / EXPANSION JOINT
2.01	EXTERIOR WALL EXPANSION JOINT SYSTEM	It includes providing & fixing of the Wall to Wall Expansion Joints system of width specified in structural drawings. It shall be manufactured from the Aluminium Alloy 6063 - T66. The Expansion Joint Covers/Profile shall be supplied in 3/ 4 Metre Cut – Length. Aluminium Covers/Profiles, should have a Hard Wearing, Maintenance Free, long Lasting design. The Exposed surface of the model should have an Anodized/Mill Finish. The design of the Expansion Joint Cover System should have a Centering bar that allows and accommodate the Multi- dimensional movement capabilities. The system must comply Cycle Movement Test as per ASTM – 1399 Part 4. The Expansion Joint System will have side Profile/Mounting bracket allowing for secure fixing and Flexible anchoring of the system to the Vertical Surface. Fire Barrier (UL Certified) as specified and per the Manufacturer’s Standards shall be used/Installed before installation of the Expansion Joint Cover. Exterior Wall Expansion Joint Covers/Models shall have a mandatory Installation of Moisture / Water Proofing of the Expansion Joint by the way of Sealing the Joint with the additional Membrane with Epoxy sealing agent & other means i.e., the Anchor fasteners in the Exterior elevation Wall or on the Exterior Façade System of the building will have to be done in order to prevent of any water seepages during rain or by other possibilities.
2.02	FLOOR EXPANSION JOINT SYSTEM	It includes providing & fixing of the floor expansion joint system (SPJ) of width specified in structural drawings. It shall be manufactured from the Aluminium Alloy 6063 - T66. The Expansion Joint Covers/Profile shall be supplied in 3/ 4 Metre cut – Length. Aluminium Covers Profiles should have a Hard Wearing, Maintenance Free, long lasting design. The design of the Pan should be such that there is no requirement of the diagonal cutting of the infill i.e., stone & tiles. The Exposed surface/Edge of the pan model should have a visible width of 65 mm (+/-5%) & Serrated Surface, which should ensure to have a good Skid Resistance so that it avoids any kind of Slippages during its usage. The design of the Expansion Joint Cover System should be such that it should pop up with the infill in case of earthquake when the closure of Joint width happens during earthquake. The Expansion Joint Cover should have a Centering bar that allows and accommodate the Multi- dimensional movement capabilities. The system must comply Cycle Movement Test as per ASTM – 1399 Part 4. Test Certificate has to be mandatorily submitted along with Supplies. The total width of the Expansion Joint shall be as per manufacturer’s specifications. The system can be used for standard pedestrian loads & Cart-Wheel Loads if required. The Side Profile should have a MULTI HOLE mounting bracket allowing for secure fixing and Flexible anchoring and excellent bonding with given slab surface/masonry/epoxy bedding. For Precise Transitions, the factory supplied slid-in connection pins should be used during the installation of the cover system in multiple Cut-Length for achieving

S.No.	Item	Description of Item
		<p>the Straight-line alignment. Water Proofing of the Expansion Joint by the way of sealing the Joint with the additional Membrane with Epoxy sealing agent will have to be done. Fire Barrier (UL Certified) as specified and per the Manufacturer's Standards shall be used/Installed before installation of the Expansion Joint Cover.</p>
2.03	<p>ROOF COVER EXPANSION JOINT SYSTEM</p>	<p>It includes providing & fixing Roof Top Expansion Joints (Earthquake-resistant Series Model) for width specified in structural drawings. It shall be manufactured from the Aluminium Alloy 6063 - T66. The Expansion Joint Covers/Profile shall be supplied in 3/ 4 Mtrs. Cut – Length. Aluminium Covers Profiles should have a Hard Wearing, Maintenance Free, long lasting design having Smooth Surface. The Surface of the Exp. Joint Covers should have Smooth Surface, which should ensure to have a good water slippage so that it avoids any kind of hold of any water droplets on its top Surface when in use during rains or other times of any water spillage on the Cover Surface. Additionally, Moisture / Water Proofing of the Expansion Joint by the way of sealing the Joint with the Membrane with Epoxy sealing agent will have to done mandatorily. The design of the Expansion Joint Cover System should be such that it should have a free horizontal movement in case of earthquake. The movement in the cover, should be supported with a Centering Bar, which should return to its original position after each movement large or small. The system must comply Cycle Movement Test as per ASTM – 1399 Part 4. Test Certificate has to be mandatorily submitted along the with Supplies. The Side Profile should have a MULTI HOLE mounting bracket allowing for secure fixing and Flexible anchoring and excellent bonding with given slab surface/masonry/epoxy bedding. For Precise Transitions, the factory supplied slid-in connection pins should be used during the installation of the cover system for connecting one Cover Profile to another when being installed in one Continuation Joint Length in multiple Cut-Length for achieving the Straight-line alignment. Fire Barrier (UL Certified) as specified and per the Manufacturer Standards shall be used/Installed before installation of the Expansion Joint Cover. Water Proofing of the Expansion Joint by the way of sealing the Joint with the additional Membrane with Epoxy sealing agent will have to be done.</p>
2.04	<p>FIRE BARRIER</p>	<p>Providing & fixing of fire seal / barrier for all expansion joint systems. The Fire barrier should be constructed by the use Alkaline Earth Silicate wool product in Stainless Steel encasing which should have a UL Certification for minimum of 2 Hrs. The Fire Barrier shall be supplied in Various Cut-Length depending on the Joint Width in Roll Form. The Fire barrier should be Asbestos Free for health & safety reasons/standards. The ANSI/UL 2079 Standards should be followed i.e. "Tests for Fire Resistance of Building Joint System". Both the Edges of the Stainless Steel encase should be welded by the Seam Welding Process, so that it gives flexibility during the Installation. As per site condition Surface Mounting Flanges can be provided or the same can also be secured along with the Anchors / Fasteners of the Multi Hole Mounting Brackets of the Exp. Joint Covers. The Fire barrier should have a 100 % Movement of the Joint width (+) 50 % / (-) 50 % at least in order to provide the Unhindered Expansion & Seismic Movement of the Mechanical/Metal Expansion Joint Covers. The system must comply Cycle Movement Test as per ASTM – 1399 Part 4. Test Certificate has to be mandatorily submitted along the with Supplies. The UL Certificate should be in the name of the Manufacturer of the Expansion Joint Cover System.</p>

S.No.	Item	Description of Item
3.00		MASONRY WALLS
3.01		External walls and internal partitions / walls shall be provided as per drawings / Schedule.
3.02		Any cement slurry added over base surface (or) for continuation of concreting for better bond
3.03	Internal and external walls	AAC blocks masonry shall be of Grade I and of oven dry density 551-650 kg/cum with cement mortar 1:4 (1 cement; 4 coarse sand) / polymer modified adhesive mortar above plinth level except wet areas. The polymer modified adhesive mortar shall be provided @ 30 kg per cum. AAC Block conforming the IS Code – 2185 (Part-3) 1984 (Reaffirmed 2005) shall be used.
3.04	Wet area walls	Clay brick masonry of class designation 7.5, with cement mortar 1:6 (1 cement: 6 coarse sand), shall be done in wet areas. FPS bricks of class designation 7.5 in cement mortar 1:6 (1 Cement: 6 Coarse Sand) shall be used in brick work in foundation upto plinth level and other masonry work shown in drawings. All the walls of corridors shall be full brick wall or with 200mm thick AAC blocks as shown in GFC drawings.
3.05	RCC band in AAC walls	For masonry work above plinth level, RCC band at sill level and lintel level shall be provided. This thickness of the band shall be minimum 100 mm high or as per GFC drawings.
3.06	RCC lintels over openings	All opening on masonry wall shall be provided with RCC lintels cast in situ or precast as per opening size, RCC bands / lintel over top of parapet wall at corridors, balconies etc. with specified grade of concrete as shown in the GFC drawing.
3.07	Utility ducts	Wherever utility ducts, drains etc. are required, the same shall be provided with precast concrete elements made of M-25 grade concrete and reinforcement steel of Fe-500D.
3.09	Masonry Walls	Providing and laying Autoclaved Aerated concrete (AAC) blocks masonry 100 mm/ 125 mm thick with Grade- I AAC blocks of density 551 to 650 Kg/ cum conforming to IS: 2185 (Parts-3) in super structure above plinth level up to floor V level in cement mortar 1:4 (1 cement : 4 coarse sand).
3.10	Masonry walls	Providing and laying Autoclaved Aerated concrete (AAC) blocks masonry 150mm/230mm/300 mm thick with Grade- I AAC blocks in super structure above plinth level with RCC band at sill level and lintel level with cement mortar 1:4 (1 cement : coarse sand) all complete as per direction of Engineer-in-Charge.
3.11	Masonry walls	Half brick masonry with clay bricks of class designation 7.5, , in super structure above plinth in Cement mortar 1 : 4 (1 cement : 4 coarse sand)

S.No.	Item	Description of Item
3.12	Solid dry partition WL-01	Providing and fixing 75 mm overall thickness partition with 12.5 mm thick double skin fire rated Glass Reinforced Gypsum (GRG) plaster board conforming to IS: 2095: part 3 (Board with BIS certification marks) upto ceiling height consisting of G.I. frame and required board, including providing and fixing of frame work made of special section power pressed/ roll form G.I. sheet with zinc coating of 120 gms/sqm(both side inclusive), consisting of floor and ceiling channel 50mm wide having equal flanges of 32 mm and 0.50 mm thick, fixed to the floor and ceiling at the spacing of 610 mm centre to centre with dash fastener of 12.5 mm dia meter 50 mm length or suitable anchor fastener or metal screws with nylon plugs and the studs 48 mm wide having one flange of 34 mm and other flange 36 mm and 0.50 mm thick fixed vertically within flanges of floor and ceiling channel and placed at a spacing of 610 mm centre to centre by 6 mm dia bolts and nuts, including fixing of studs along both ends of partition fixed flush to wall with suitable anchor fastener or metal screws with nylon plugs at spacing of 450 mm centre to centre, and fixing of boards to both side of frame work by 25 mm long dry wall screws on studs, floor and ceiling channels at the spacing of 300 mm centre to centre. The boards are to be fixed to the frame work with joints staggered to avoid through cracks, M.S. fixing channel of 99 mm width (0.9 mm thick having two flanges of 9.5 mm each) to be provided at the horizontal joints of two boards, fixed to the studs using metal to metal flat head screws, including jointing and finishing to a flush finish with recommended jointing compound, jointing tape, angle beads at corners (25 mm x 25 mm x 0.5 mm), joint finisher and two coats of primer suitable for board as per manufacture's specification and direction of engineer in charge all complete.
3.13	Insulation in dry partitions	Providing and fixing thermal insulation with Resin Bonded rock wool conforming to IS: 8183, having density 48 kg/m ³ , 50 mm thick, wrapped in 200 G Virgin Polythene Bags fixed to wall with screw, rawl plug & washers and held in position by criss crossing GI wire etc. complete as per directions of Engineer- in- Charge.
4.00		WALL FINISH - PLASTERING
4.01	Cement plaster on clay / fly ash brick walls	All brick wall shall be finished with 12mm (1:6) thick cement plaster and 15mm (1:6) cement plaster on rough side. The contractor is free to use ready-mix plaster of approved make in place of cement plaster. Cement plaster on walls shall be done in true plumb and line in all areas i/c RCC portion of column / beam in between.
4.02	Mesh at joints	Chicken mesh 85gsm or fibre mesh of good quality to be provided in plaster at the junction of Masonry and RCC or CC Member / band.
4.03	Plaster on AAC Block walls	All internal AAC walls shall be finished with 12 mm thick (average) premixed formulated one coat gypsum lightweight plaster having additives and light weight aggregates as vermiculite/ perlite respectively conforming to IS: 2547 (Part - 1 & II) 1976, applied on hacked / uneven background such as bare brick/ block/ RCC work on walls & ceiling at all floors and locations, finished in smooth line and level etc. complete.
4.04	Projections	Cement plaster in cement mortar 1:3 to be done on ceilings, soffits.

S.No.	Item	Description of Item
4.05	Gypsum plaster on walls	Gypsum plaster shall be executed using pneumatic spray machine of reputed make, as shown in GFC drawings / or as agreed.
4.06	Cement plaster	12 mm cement plaster of mix : 1:6 (1 cement: 6 coarse sand) on all types of walls at all levels.
5.00		DOOR, WINDOWS, GLAZING
5.01		Doors, windows, ventilators including fittings fixtures and glazing shall be provided as per Finishing / Door window Schedule.
5.02	Door frames fixing	Wherever the doors are required to be fixed to AAC block masonry, the frame shall be fixed in RCC band or concrete block masonry.
5.03	Flush Door Shutters as per door window schedule	Flush door shutters shall be of 35 mm thick or of thickness as specified/required/decided (in door & window schedule or in drawings) and conforming to IS: 2202 (Part I) decorative type, core of block board construction with frame of 1st class hard wood and well matched teak 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters. Stainless Steel butt hinges with necessary screws shall be used for fixing. Lipping with 2nd class teak wood battens of 25 mm minimum depth on all edges of flush door shutters shall be provided. Rebate shall be cut (in frames/shutters) as specified and instructed by Engineer-in-charge. Vision panel of required and specified shape e.g. rectangular, square, circular etc. shall be provided.
5.04	Flush door	Laminates on flush doors shall be machine pressed, preferably in factory. The design and pattern of laminates shall be as per the approval of Engineer-in-charge.
5.05	Laminates	Flush doors shall be provided with 1.5 mm thick Decorative high pressure laminated sheet (on both side) of plain / wood grain in gloss / matt/ suede finish with high density protective surface layer and reverse side of adhesive bonding quality conforming to IS: 2046 Type S, including adhesive of approved quality. The laminates shall be resistant to fungal attack at the end of 28 days of incubation when tested as per ASTM: G 21 - 2015 test method.
5.06	Metal Doors (Pressed Metal Doors):	Doors Metal Unless specified otherwise, frame shall be single rebate profile made out of 1.20mm thick (minimum) galvanized steel sheet (18 gauge) and Door shutter shall be single leaf/double leaf fully flush double skin with or without vision panel manufactured from 1.2mm (18 gauge) minimum thick galvanized steel sheet. The profile of frame and thickness of shutter shall be as per manufacturer's specifications. Frames should be mitred, field assembled with self-tab. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate for anchor fasteners for installation on a finished plastered wall opening. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb core. For Double leaf doors astragal has to be provided on meeting stile for both active and inactive leaf. All doors should be finished with Powder coating (minimum 60 micron) in desired regular RAL Shades.

S.No.	Item	Description of Item
5.07	FRP doors	Fiber Glass Reinforced plastic (FRP) Door Frames shall have cross-section 90 mm x 45 mm with single rebate of 32 mm x 15mm to receive shutter of 30 mm thickness. Door frame laminate shall be 2 mm thick and shall be filled with suitable wooden block in all the three legs. The laminate shall be moulded with fire resistant grade unsaturated polyester resin and chopped mat. The frame shall be covered with fiber glass from all sides. M.S. stay shall be provided at the bottom to steady the frame. Fiberglass Reinforced Plastic (F.R.P.) flush door shutter of (30 mm thickness) should consist in different plain and wood finish made with fire retardant grade unsaturated polyester resin, moulded to 3mm thick FRP laminate all around, with suitable wooden blocks inside at required places for fixing of fittings and polyurethane foam (PUF)/ Polystyrene foam to be used as filler material throughout the hollow panel, casted monolithically with testing parameters of F.R.P. laminate conforming to table - 3 of IS: 14856, as per direction of Engineer-in-charge.
5.08	High Pressure Compact Laminate Board Cladding as per finishing schedule	HPL board cladding as per finishing schedule in 8 mm thick High Pressure interior compact Laminate made out of thermosetting resin treated, Kraft as core material and design paper as a finish surface. The compact laminates should be resistant to water immersion through permissible increase on thickness and mass <0.60% and board should have density >1.35kg/cm ³ . Compact laminates should be flame retardant and fulfil the criteria of classification of B-s1, d0 of EN 13501-1. It shall have Anti-bacterial and anti- termite property as per JIS Z2801:2000, Chemical resistance, Scratch resistant, fire resistance, weather & climatic shock resistance. It should fulfil the criteria of FSC and Green Guard Gold certification and manufactured under EN438-2&3:2005 standard. Finish and colour of compact laminates should be finalized under direction of Engineer –in-charge. Compact laminates should be installed on 25x50mm aluminium tube or approved tube size at 500mm c/c under desirable height and fixed through same compact colour rivets or compact adhesive as per recommended by manufacturer’s specification/instructions. Finish and colour of Interior clade should be approved under engineer-in-charge direction. The manufacturer should provide 10 years warranty certification on any manufacturing and moisture related defects.
5.10	Door frames	Door frame shall be double rebate profile of size 143 x 57mm made out of 2.0mm (14gauge) thick galvanized steel sheet. Frames shall be butted and field assembled with bolts. The inside face of the frame face trim to rebate height should be protected with lead line of minimum 2.0 mm thickness or as specified/required. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Rubber door silencers should be provided on the strike jamb. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Once frame installed should be grouted with cement & sand slurry necessary for doors on the clear masonry opening.

S.No.	Item	Description of Item
5.11	Door shutter	Door leaf shall be 48mm thick or of thickness as specified/required fully flush double skin door. Door leaf shall be manufactured from 1.6 mm (16gauge) thick galvanised steel sheet. The internal construction of the door should be rigid with lead line of minimum 2 mm thick or as specified/required all across the inside of the exposed surface. In addition the door should have a basic infill steel stiffened special core with necessary reinforcement both on top and bottom. All doors should be factory prepared for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers suitable for Lead line doors like weight of lead doors are very height in comerison to normal doors & lead lining should not be break anywhere in the complete frame and shutter due to fixing of hardware or gap between frame shutter or by astragal so if such locations arises then its cover by any other way of lead lining (as per ANSI Standard). The edges should be interlocked with lock seam. For pair of doors integrated astragals has to be provided on the meeting stile for both active and inactive leaf.
5.12	Glazed Doors	All the glazed doors (non-fire rated) shall be made in Aluminium door frames, shutters of suitable section, (with powder coating in required shade and colour of not less than 50 microns), toughened glass with necessary fittings and fixtures of stainless steel (SS 304) required to make the door operational and function smoothly, complete as per directions of Engineer-in-charge (necessary shop drawings should be prepared by the contractor and work shall be executed after obtaining approval from Engineer-in-charge). The thickness of glazing should not be less than 8 mm.
5.13	Wire mesh shutters	SS 304 mosquito proof shutters shall be made as per requirement for external doors.
5.14	HARDWARE FOR DOORS /WINDOWS	All fittings and fixtures shall be as per hardware schedule for doors / windows (mentioned in tender document) and got approved from the Engineer-in-Charge before procurement well in advance and the approved samples shall be kept at site till completion of the work.
5.15	BUTT HINGES	5 Knuckle, 2 bearing butt hinges size 4" x 3" x 3mm, in SS 304 and in satin stainless steel as per EN 1935, CE Marked suitable for door weights upto 120kgs
5.16	VISION PANEL	Unless otherwise specified, toughened glass of 6 mm thickness.
5.17	GRAVITY COORDINATOR	Door coordinator /sequencer for the double leaf doors
5.18	DOOR LOCK	55mm back set, 20mm square forend prepared for euro profile cylinder including strike plate. and EPC 70mm Length both side key operation & Escutcheons in SSS Finish
5.19	FLUSH BOLT	Lever action flush bolt with 19mm projecting bolt (LENGTH 172 mm OR 300 MM As per schedule) in satin chrome
5.20	FLOOR SOCKET	Spring loaded dust excluding floor socket with fixing accessories, in satin Chrome finish of make

S.No.	Item	Description of Item
5.21	PA BRACKET	Parallel arm bracket suitable for surface mounted door closer for fixing of door closer in Silver finish
5.22	ARMOR PLATE	Armour plate with smoothed edges and rounded corners flush face fixing screws height 1000mm and thickness 1.2 mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width
5.23	PUSH PLATE	Push plate with smoothed edges and rounded corners flush face fixing screws size 150 x 400 x 1.2 mm in SS 304 grade in satin stainless steel
5.24	SIGN PLATES	Male / Female / Disable sign plate for WC application with fixing screws size 150x150x1.2 mm, rounded corners in SS 304 satin stainless steel finish with marking in black
5.25	MOP PLATE	Mop plate with smoothed edges and rounded corners flush face fixing screws height 150mm and thickness 0.9mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width. Max door width =1200mm
5.26	KICK PLATE	Kick plate with smoothed edges and rounded corners flush face fixing screws height 300mm and thickness 1.2 mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width
5.27	D- TYPE HANDLE	D type 300mm long CTC, 22mm Dia Pair of pull handle in SS 304 B/B
5.28	D- TYPE HANDLE	Off set type D handle of 450mm long CTC, 25mm Dia pair of handle in SS 304 B/B
5.29	FLUSH PULL HANDLE	Stainless steel Flush Pull handle with fixing of screw at flush with surface of doors
5.30	Door Closer	Aluminium die cast body tubular type universal hydraulic door closer (having brand logo with ISI mark, IS: 3564, embossed on the body, with necessary accessories and screws etc.
5.31	Door Closer	Supply & fixing rack and pinion door closer TS 72 EN size 2-4, with std. arm and with two independent closing valves and latching speed adjustable by arm. All adjustment screws face fixed. Silver finish. As per EN 1154. .
5.32	Door closer	Supply & fixing rack and pinion door closer TS 83 EN size 7, with backcheck and standard arm with two independent closing valves and latching speed adjustable by arm. All adjustment screws face fixed with slide plate. Silver finish. As per EN 1154 and CE marked. .
5.33	Door closer	Supply & fixing rack and pinion door closer TS 89 F EN size 3-6, with standard arm and two independent closing valves and latching speed adjustable by arm. All adjustment screws face fixed with slide plate. Silver finish. As per EN 1154 and CE marked.
5.34	Stainless Steel handles	Bright /matt finished Stainless Steel handles (Window) of approved quality with necessary screws etc.
5.35	Pull Handle	Pull Handle: 25mm dia , 300 mm long in cranked / square shape stainless steel (Grade 304) satin finish pull handle with necessary screws etc. (

S.No.	Item	Description of Item
5.36	Sliding Door Bolt	250x16mm Stainless steel (Grade 304) satin finish sliding door bolts of superior quality with necessary SS screws etc.
5.37	Door stoppers	Wall mounted door stoppers shall be provided to protect the wall where the door handle would run into it. Stainless Steel (grade 304) wall mounted or hanging floor door stoppers in stainless steel satin finish with necessary ss screws etc.
5.38	Mortice Latch	Brushed finished 100mm mortice latch in stainless steel satin/polished finish with euro deadlock (Coin release) with rose rings and pair of stainless steel (grade 304) lever handles with necessary SS screws etc.
5.39	Tower Bolt	Stainless steel (Grade 304) tower bolts with necessary SS screws etc. complete.
5.40	FIRE RATED DOORS & Doorset as per door window schedule	The fire rated doors & doorset should comply with IS:3614-2021 conforming to FD-120-130 classification, National Building Code (NBC) 2016. Fire Check doors shall be provided in buildings wherever necessary and required as per National Building Code 2016, as per door & window schedule and as per architectural drawing provided with tender document. Unless otherwise specified elsewhere in tender document, all fire doors should be fire rated for 120 minute and doors of fire exit corridor should meet the requirement of fire exit corridor specified in NBC 2016.
5.41		In general, all the services / electrical rooms / shafts shall be provided with Metal Fire rated doors whereas all the lobbies, entry / exit to corridors shall be provided with the Glazed fire check / rated doors.
5.42	Glazed Fire Rated Doors / Window / Partition	Fire rated glazed door / window / fixed partition, shall be provided as per following specification.
5.43	Partition Frame	Non load bearing fixed frame for fire resistant glazed Partition for 120 min Fire Rating, should be made out to a profile of dimension 60mm x 70 mm of 1.6 mm thick galvanised steel sheet as per test evidence suitable for fixing fire rated glass for 120 min of both integrity & radiation control (EW120) & minimum 20 min of insulation (EI20).The profile has to be fixed to the supporting construction by means of anchor fasteners of size M10 x 80, every 150 mm from the edges and every 500 mm (approx.) c/c. The frame shall be filled with mineral wool insulation of density min 96kg/m ³ and finished with an approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in-charge.

S.No.	Item	Description of Item
5.44	Partition Frame	Fire resistant door frame of section 50 x 60 mm on horizontal side & 35 x 60 mm on vertical sides having built in rebate made out of 1.6 mm thick GI sheet (Zinc coating not less than 120gm/ m ²) suitable for mounting 120 min Fire Rated Glazed Door Shutters. The frame shall be filled with Mineral wool Insulation having density min 96 Kg/m ³ . The frame will have a provision of G.I. Anchor fasteners 14 nos (5 each on vertical style & 4 on horizontal style of size M10 x 80) suitable for fixing in the opening along with Factory made Template for SS Ball Bearing Hinges of Size 100x89x3mm for fixing of fire rated glazed shutter . The frame shall be finished with an approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in- charge.
5.45	Glazed door shutter	Glazed fire resistant door shutters should be 60 mm thick with suitable mounting on door frame, consisting of vertical styles, top rail & side rail 60 mm x 60 mm wide and bottom rail of 110 mm x 60 mm made out of 1.6mm thick G.I. sheet (zinc coating not less than 120gm/m ²) duly filled mineral wool insulation having density min 96 kg/ m ³ and fixing with necessary stainless steel ball bearing hinges of size 100x89x3mm of approved make, including applying a coat of approved fire resistant primer or powder coating not less than 30 micron etc. all complete as per direction of Engineer-in-charge. Glazed fire resistant door shutters should be having 120 min Fire Rating confirming to IS:3614 (Part II) or EN1634-1:1999, tested and certified as per laboratory approved by Engineer-in-charge.
5.46	Fire resistance shutter	Providing and fixing glazing in fire resistant door shutters, fixed panels & partitions etc., with G.I. beading made out of 1.6 mm thick G.I. sheet (zinc coating not less than 120 gm/m ²) of size 20 x 33 mm screwed with M4 x 38 mm SS screws at distance 75 mm from the edges and 150 mm c/c , including applying a coat of approved fire resistant primer/ powder coating of not less than 30 micron on G.I. beading, & special ceramic tape of 5 x 20 mm size etc. complete in all respect as per NBC 2016, IS 16231 (Part 3):2016 and as per direction of Engineer-in-charge with bidirectional interlayered glass of required thickness having 120 minutes of fire resistance both integrity & radiation control (EW120) and minimum 20 minutes of insulation (EI20). The manufacturer has to give test report/certification of fire glass and the glass should have the stamp showing the value of E, EW & EI. The glass shall be tested in approved NABL accredited lab or by any other accreditation body which operates in accordance with ISO/IEC 17011 and accredits labs as per ISO/IEC 17025 for testing and calibration scopes shall be eligible.
5.47	Metal Fire Rated Doors	Metal Fire door shall be from ISO 9001:2015 certified manufacturer. The door must have been manufactured with galvanised - GI sheet of GPSP Grade as per IS 277. All Fire doors must satisfy the requirement of latest NBC 2016 Part 4 for Fire & Life Safety guidelines. The Prototype sample of the door must carry a prior test evidence as per IS 3614 part-2 / BS 476 Part 20 & 22. The manufacturer must submit the copy of test evidence prior to start of reduction offered test certificate should either carries it's Validity or certificate must not be older than 5 years from CBRI / NABL Accredited Lab. All doors should be finished with Powder coating (minimum 60 micron) in desired regular RAL Shades.

S.No.	Item	Description of Item
5.48	Door frame	Door frame shall be Single rebate profile of section 125 x 55 mm made out of minimum 1.20mm thick galvanised steel sheet with a factory pre-punched groove so as to accommodate fire seal size (minimum 10x4mm). Frames should be mitred, butt jointed and field assembled with bolting system for proper strength. Frames shall have in built grooved sealing system and shall be site fitted with fire rated EPDM gasket as standard. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate for anchor fasteners for installation on a finished plastered wall opening.
5.49	Door shutter	Door leaf should be minimum 46mm thick fully flush double skin door. Door leaf must be manufactured from minimum 1.2 mm (18 gauge) thick galvanised steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb core. For Double leaf doors astragal has to be provided on meeting stile for both active and inactive leaf. Vision panels wherever required should be provided with specified shape and sizes of glass (bidirectional interlayered glass of required thickness).
5.50	Wooden Fire Rated Door	Wooden Door Frame shall be of section 145mm x 70mm with heat activated intumescent fire seal (of approved make) strip of size 20mm x 4mm and one coat of anti-termite fire retardant Primer. The door frame shall be fixed with dash fastener or chemical fastener (minimum four no. on each side). Wooden shutter shall be of 55mm thick asbestos free composite fire / smoke check wooden shutters of 120 minute fire rating confirming to BS: 476 Part 22 & IS: 3614 Part II comprising of two 9mm thick Re-enforced Calcium Silicate boards, 100% without Asbestos, Brucite and Meerscham, having density not less than ≤ 1150 Kg/M ³ and thermal conductive 0.14 W/m*K sandwiching 31mm thick fire resistance insulation filler coated with FR silicon sealant and faced with 3mm thick commercial ply on both side with heat activated intumescent fire seal strip of size 20mm x 4mm mounted in the grooves of hardwood lipping on all sides except bottom. The intumescent sealant is used to fill the gaps between board and internal wooden lipping with 1.5 mm laminate on both side for fire door.
5.51	FIRE RATED HARDWARE FOR FIRE DOORS	All hardware's for fire rated doors shall also be fire rated and shall have certification from UL/CE.
5.52	DOOR CLOSER	Extruded aluminium body Heavy duty Fire Rated Door Closers with full body cover. The Door Closers should be spring adjustable type 2-6, Non handed with back check, and tested along with the fire doors from CBRI Roorkee as per BS476 Part-22 and IS 3614 Part-2. The door closer shall have 10 years mechanical warranty from the manufacturer and complies with EN 1154- for 50000 cycles + A1: 2002 CE Certified
5.53	BUTT HINGES	5 Knuckle, 2 bearing butt hinges size 4" x 3" x 3mm, in SS 304 and in satin stainless steel as per EN 1935, CE Marked suitable for door weights upto 120kgs.

S.No.	Item	Description of Item
5.54	VISION PANEL	a) Unless otherwise specified, bidirectional interlayered glass of 15 mm thickness shall be used.
5.55	GRAVITY COORDINATOR	Door coordinator /sequencer for the double leaf doors
5.56	PANIC BAR-SINGLE POINT	Panic bar / latch (Single point) suitable for single / active leaf of door
5.57	PANIC BAR-TWO POINT OR DOUBLE POINT	Panic bar / latch (Two point or Double point) with vertical rod and top and bottom latch suitable for double doors or inactive leaf of door of
5.58	EXTERNAL TRIM	a) External trim on back side of the Panic Latch
5.59	ELECTROMAGNETIC HOLD OPEN	Electro Magnetic hold open device for holding the door in open condition EM with armature plate with 24v DC
5.60	EM LOCK FOR HOLD OPEN DOOR	Holding force of 1200 lbs. EM Lock with 1200 ALH and EM 1200 2ALH with armature receiving plate, surface mounted 12/24 vDC including armature plate holder
5.61	DOOR BOTTOM SEAL	Automatic Door Bottom Seal, Heavy Duty, Face Mounted Version, spring loaded to lift clear of the floor as soon as the door leaf is opened, suitable to be used on Fire and smoke check doors, Seal Material = Silicon, Finish = Anodized Satin Clear, Length = 48" IN SATIN CLEAR FINISH
5.62	DELTA SEAL	Delta Seal for acoustic, fire and smoke protection, suitable for wooden and steel frames, self-adhesive, Finish = Black, Length = 1 x as required, Height- 2 x as required IN BLACK FINISH
5.63	Frameless glass partition	Frameless glass partition and doors shall be made out of 12 mm thick (minimum) toughened glass of approved brand and manufacture, including providing and fixing arrangement and making necessary holes etc. for fixing required fittings, all complete
5.64	Frameless glass doors	Frameless glass doors shall be made out of 12 mm thick (minimum) toughened glass of approved brand and manufacture, including providing and fixing top & bottom pivot & double action hydraulic floor spring, fixing arrangement and making necessary holes etc. for fixing required fittings, all complete as per direction of Engineer-in-charge.
5.65	Hydraulic floor spring for doors	It shall be double action hydraulic floor spring conforming to IS : 6315, having brand logo embossed on the body / plate with double spring mechanism and door weight upto 125 kg, for doors, cover plates with brass pivot and single piece M.S. sheet outer box with slide plate etc.

S.No.	Item	Description of Item
5.66	weather silicone sealant on external windows, glazing	For the aluminium windows, the gap between the aluminium frames and the R.C.C / Masonry and also any gaps in the various sections shall be filled with weather silicone sealant DC 795 of Dow Corning or equivalent in the required bite size, to ensure water tightness including providing and fixing backer rod, wherever required.
5.68	Window security grills	M.S. grill shall be provided in windows, weight of grill in each window should not be less than 12 kg/sqm or as per GFC drawings.
5.69	Ladders for Overhead Tank	Unless otherwise specified, Monkey ladder shall be provided for overhead water tanks, mummy and lift machine room doors with frame and steps of 40x40x6 mm angle iron, etc. duly painted with synthetic enamel paint.
6.00		FLOORING, MARBLE, CLADDING WORK
6.01		Internal finishing like Flooring / skirting / dado / panelling shall be provided as per Finishing Schedule.
6.02		Skirting minimum 150 mm high to be provided / or as per schedule.
6.03		Levelling concrete course to be provided on the top of RCC slab before laying flooring as per site requirement, if required.
6.04	Polished Kota Stone flooring, treads as per finishing schedule	25mm thick Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand). average size 550mm x 550mm
6.05	Polished granite stone flooring / treads / risers as per finishing schedule	Providing and laying Polished Granite stone flooring in required design and patterns, in linear as well as curvilinear portions of the building all complete as per the architectural drawings with 18-20 mm thick stone slab over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade including rubbing , curing and polishing etc. all complete as specified and as directed by the Engineer-in-Charge. - Polished Granite stone slab colour as per finishing schedule. (Basic cost of slabs Rs. 2000 -2200 per sqm landed in Guwahati as sample approved by Employer) type F1
6.06	Cement concrete flooring as per finishing schedule	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slurry, but excluding the cost of nosing of steps etc. complete. 40 mm thick with 20 mm nominal size stone aggregate

S.No.	Item	Description of Item
6.07	Polished Vitrified tiles in floors as per finishing schedule	Providing and laying Vitrified tiles in floor in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS:15622, of approved brand & manufacturer, in all colours and shade, laid on 20 mm thick cement mortar 1:4 (1 cement: 4 coarse sand) jointing with grey cement slurry @3.3 kg/sqm including grouting the joints with white cement and matching pigments etc. The tiles must be cut with the zero chipping diamond cutters only. Laying of tiles will be done with the notch trowel, plier, wedge, clips of required thickness, leveling system and rubber mallet for placing the tiles gently and easily. Double charge vitrified tile polished finish of size 600mm x 600mm (Approved tiles with basic cost Rs. 560 to 600 per sqm landed in Guwahati)
6.08	Epoxy grouting of tiles as per finishing schedule	Grouting the joints of flooring stone having joints of 2 mm spacer, using anti-bacterial epoxy grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardener and 0.20 kg of resin per kg), including filling / grouting and finishing complete as per direction of Engineer-in-charge.
6.09	Mirror polished engineered marble flooring as per finishing schedule	Providing and laying machine cut, mirror polished composite engineered Marble stone flooring, in required design (Simple geometrical, abstract etc.) and in patterns in combination with Italian marble stones of different colours, shades and finished surface texture etc., in linear portions of the building, all complete as per the architectural drawings, with 18 mm thick stone slab laid over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with white cement slurry @ 4.4 kg/sqm, including pointing with white cement slurry admixed with pigment to match the marble shade, including rubbing, curing and polishing etc. all complete as specified and as directed by the Engineer-in-Charge.
6.10	Adhesive mortar for tile laying	All the tiles (flooring / wall lining / Skirting / dado) shall be fixed with quick set tile adhesive of minimum thickness of 6 mm. Also joints of flooring tiles having 3 mm width shall be grouted using epoxy grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardener and 0.20 kg of resin per kg).
6.11	Cement mortar for stone laying in flooring	Unless specified otherwise, all stone/granite/marble in flooring shall be laid on 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade.
6.12	Cement mortar for stone laying in dado / cladding / skirting	Unless otherwise specified, all stone/granite/marble in skirting/wall lining/dado shall be fixed on 20 mm (average) thick base of cement mortar 1:3 (1 cement : 3 coarse sand) and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade.

S.No.	Item	Description of Item
6.13	Tactile tile flooring	Tactile tile such as directional, warning or hazardous (for vision impaired persons as per standards) shall be of size 300x300x15 mm {10 mm base + (5mm ± 0.5mm) thick raised portion} having water absorption less than 0.5% and conforming to IS: 15622 of approved make in all colours (preferably yellow) and shades for indoor floors, should be laid on 20mm thick base of cement mortar 1:4 (1cement : 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc. as per harmonized guidelines and space standards for barrier free built environments for persons with disability and elderly persons issued by Ministry of Urban Development, Govt. of India.
6.14	Self-adhesive yellow tape on treads	50 mm wide Yellow colour, self-adhesive 'EDGE STRIPS' of approved make shall be provided on risers of staircase to help persons with visual disabilities and elderly. 25 mm wide high intensity Anti-Skid reflective tape of approved make on edges of treads of staircase shall be provided.
6.15	Vinyl sheet flooring 2mm thick as per finishing schedule	Vinyl flooring shall be having thickness of 2mm (minimum) as per EN 428, weight less than 2900 gms/sqm as per EN 430, Fire rating class Bfl-s1 as per EN 13 501-1 , Static electrical propensity < 2 kV as per EN 1815, Slip resistance wet : ramp test with oil (1) of class R10 as per DIN 51 130, Wear resistance of ≤2.0 as per EN 660.2, wear group 'T' as per NF189, binder content of type -I as per ISO 10582, dimensional stability of ≤0.4 as per EN 434, Indentation ~0.03 (< 0.10) mm as per standard ISO 24343 – 1, impact sound insulation of 8 dB as per EN ISO 712-2, thermal conductivity of 0.25 W/m.K as per EN 12524, colour fastness rating of ≥ 6 degree as per EN 20105-B02, Product should confirm to FloorScore® Indoor Air Quality Certified (≤ 10 µg / m3 as per ISO 16000-6), performance (ok) in castor chair test (type W) as per ISO 4918 (EN 425), anti-bacterial activity (> 99 % inhibits growth as per ISO 22196). The thickness of wear layer would be 2mm. The product should be homogeneous and single layered. The product shall be classified as class 34-42 as per EN 685.
6.16		Installation- It is important to ensure the subfloor on which the sheet is being laid is smooth, flat, hard and free from moisture, grease etc. In case of uneven subfloor the same should be levelled using self-levelling compound. IPS Vitrified/ceramic/ mosaic tiles do not provide zero levelled sub floor. The moisture present in the subfloor should be less than 8% before installation of the floor. The vinyl flooring sheet should be installed with coving profile & adhesive recommended by Vinyl Flooring manufacturer.

S.No.	Item	Description of Item
6.17	Vinyl sheet skirting 2mm thick as per finishing schedule	The floor finish should terminate at the room perimeter passing over a concealed coving profile and continuing up to the wall for 100mm and connected to copper strip for grounding; copper grounding strips (0.05mm thick, 50 mm width) should be laid on floor underneath conductive vinyl flooring roll. The joints in the flooring should be sealed by using a PVC welding rod of matching colour to be supplied by the manufacturer, using a hot air gun for fusion of welding rod with flooring for seamless installation.
6.18	Self leveling below PVC floor as per finishing schedule	Providing & applying self-levelling on uneven subfloor using self leveling compound of approved quality, laid at a thickness of not less than 3mm with a coverage of . over a coat of primer using steel trowel with notches to give a joint less, monolithic, smooth, thoroughly cleaned of oil or grease by suitable solvents, at all levels as per manufacturers specification. The floor finish should terminate at the room perimeter passing over a concealed cove former and continuing up the wall for 100mm. Rate shall include all materials, protection with plastic sheet, and removing the same before handing over, work at all levels etc., complete and as directed.
6.20	Anti-bacterial 1mm thick Rigid vinyl wall covering as per finishing schedule	Anti-bacterial Rigid vinyl wall covering shall be in 1 mm thickness (minimum), Impact Resistance: ASTM D256- 10EL,GB8624 -2012 , Chemical and CORROSION Resistance: Tested according to ASTM D 543- 14/ASTM D2240- 15/ASTM D638- 14, Horizontal burning:UL94HB , FLAME SPEAD AND SMOKE:ASTM E84,CLASS A , Fire rate:EN13501 - 1 ,Class B, Staining test:EN423:2001 , Mould Proof: ASTM G21-15, ISO14001 , ISO9001 , ISO45001,LCA , anti-bacterial activity (> 99 % inhibits growth as per ISO 22196). The product should be homogeneous and single layered. Installation - Installation of Vinyl Wall Covering 1.00mm thick over smooth wall surface including fixing with adhesive complete as per drawing & as directed by Engineer-in-charge. It is important to ensure the Wall on which the sheet is being pasted is smooth, flat, hard and free from moisture, grease etc.

S.No.	Item	Description of Item
6.21	Static-conductive Flexible Vinyl floor as per finishing schedule	Static-conductive Flexible Vinyl floor (non-directional homogeneous) covering shall be having thickness of 2 mm (minimum) as per EN 428, Weight ≤ 3100 gms/sqm as per EN 430, electrical resistance of $10^4 \leq R_t \leq 10^6$ Fire rating class Bfl-s1 as per EN 13 501-1, Static electrical propensity < 2 kV as per EN 1815, Slip resistance wet : ramp test with oil (1) of class R10 as per DIN 51 130, Wear resistance of ≤ 2.0 as per EN 660.2, wear group 'P' as per NF189, binder content of type -I as per ISO 10582, dimensional stability of ≤ 0.4 as per EN 434, Indentation ~ 0.03 (< 0.10) mm as per standard ISO 24343 - 1, thermal conductivity of 0.25 W/m.K as per EN 12524, colour fastness rating of ≥ 6 degree as per EN 20105-B02, Product should confirm to FloorScore® Indoor Air Quality Certified ($\leq 10 \mu\text{g} / \text{m}^3$ as per ISO 16000-6), performance (ok) in castor chair test (type W) as per ISO 4918 (EN 425), anti-bacterial activity ($> 99\%$ inhibits growth as per ISO 22196). The product shall be classified as class 34-43 as per EN 685.
6.22		Installation- It is important to ensure the subfloor on which the sheet is being laid is smooth, flat, hard and free from moisture, grease etc. In case of uneven subfloor the same should be levelled using self-levelling compound. IPS Vitrified/ceramic/ mosaic tiles do not provide zero levelled sub floor. The moisture present in the subfloor should be less than 8% before installation of the floor. The vinyl flooring sheet should be installed with coving profile & adhesive recommended by Vinyl Flooring manufacturer.
6.23		The floor finish should terminate at the room perimeter passing over a concealed coving profile and continuing up to the wall for 100mm and connected to copper strip for grounding; copper grounding strips (0.05mm thick, 50 mm width) should be laid on floor underneath conductive vinyl flooring roll. The joints in the flooring should be sealed by using a PVC welding rod of matching colour to be supplied by the manufacturer, using a hot air gun for fusion of welding rod with flooring for seamless installation.
6.24	Floor Protection	For avoiding of scratch marks or damage to the vitrified / ceramic floor tile, the necessary arrangement of hessian cloth with a coat of plaster of paris over it shall be provided.
6.25	Ceramic tile dado / skirting as per finishing schedule	Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS: 15622 of approved make, in all colours, shades as approved by Engineer-in-Charge, in skirting, risers of steps and dados, over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm, including pointing in white cement mixed with pigment of matching shade complete. - ceramic wall tiles 300x600mm -(Approved tiles with basic cost Rs.340 -380 per sqm landed in Guwahati)

S.No.	Item	Description of Item
6.26	Polished granite dado as per finishing schedule	Providing and laying polished granite stone 20mm thick in dado on walls with cement mortar 1:4 i/c jointing with polymer based pigment, edge polishing
6.26	PVC flooring 6mm thick	Providing and laying 6mm to 6.7mm thick underfoot resilience Polyflor sheet flooring for gymnasium area fixed with approved adhesive.
7.00		FALSE CEILING WORKS
7.01		Internal finishing like false ceiling shall be provided as per Finishing Schedule.
7.02	Calcium Silicate False Ceiling Tiles as per finishing schedule	Providing and fixing 15 mm thick densified tegular edged eco-friendly light weight calcium silicate anti – microbial bio-safe coated false ceiling tiles (confirming to JIS-Z2801 and ASTM G-21) of approved texture of size 595 x 595 mm in true horizontal level suspended on interlocking Metal T- Grid of hot dipped galvanised iron section of 0.33mm thick (galvanized @ 120 grams per sqm including both sides) comprising of main-T runners of size 24x38 mm of length 3000 mm, Cross - T of size 24x32 mm of length 1200 mm and secondary intermediate cross-T of size 24x32 mm of length 600mm to form grid module of size 600 x 600 mm, suspended from ceiling using galvanized mild steel items (galvanizing @ 80 grams per sqm) i.e. 12x50 mm long dash fasteners, 6 mm dia fully threaded hanger rod upto 1000 mm length and L-shape level adjuster of size 75x25x25x1.6 mm fixed with grid and Z cleat of size 25x37x25x1.6mm thick with pre-cut hole on both 25 mm flange to pierce into 12x50mm or even bigger size dash fasteners if required, fixed with Galvanised iron perimeter wall angle of size 24x24x0.40 mm of length 3000 mm to be fixed on periphery wall / partition with the help of plastic rawl plugs at 450mm center to center and 40 mm long dry wall S.S screws. The work shall be carried out as per specifications, drawing and as per directions of the Engineer-in-Charge. Note :- The calcium silicate anti –microbial bio-safe coated false ceiling tiles shall have NRC value of 0.10-0.15 (Minimum), light reflection > 85%, non- combustible as per B.S. 476 part IV, 100% humidity resistance and also having thermal conductivity of 0.048-0.052 w/m ⁰ K as per ECBC Code 2007 and ASTM 518-1991.

S.No.	Item	Description of Item
	Gypsum board ceiling as per finishing schedule	<p>Providing and fixing false ceiling at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes , finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including making openings for light fittings, grills, diffusers, cut-outs made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the Engineer in Charge</p>
	Plain gypsum board ceiling as per finishing schedule	12.5 mm thick tapered edge gypsum plain board conforming to IS: 2095- (Part I) :2011 (Board with BIS certification marks)

S.No.	Item	Description of Item
7.03	Metal False Ceiling Tile as per finishing schedule	<p>It shall be torsion spring tile ceiling system comprising of non-perforated Tile of 600mm wide and 1200mm long manufactured out of 0.5mm thick G.I sheet having galvanizing of 100 gms/sqm (both sides inclusive) and 20 % perforation area with 1.8 mm dia holes and having NRC greater than 0.5, electro statically polyester powder coated of thickness 60 micron (minimum), including factory painted after bending and perforation, and backed with a black glass fibre acoustical fleece. The metal ceiling panels shall be downward accessible with a minimum of four (4) torsion springs which is made up of SS with 2.5mm dia. The Tile will be manufactured on advanced CAD/CAM equipment that includes several levelling stages in the manufacturing process. Torsion Spring panel shall consist of two side legs die formed and two end legs die formed and punched to receive torsion springs (min two springs each end or side) for secure engagement into Tee Grid main runners which are factory punched to receive torsion springs. Tiles will be square edged. The Tile shall be Polyester powder coated with anti-bacterial coating in white colour. Panel will be pre-treated in latest Nano technology process and electro statically powder coated with automatic corona system and cured with gas catalytic technology. All ceiling shall be Green pro Certified: For LEED certification by Indian Green Building council (IGBC). Ceiling manufacturer should have in-house testing lab and powder coating line (with Nano Technology & Catalytic Converter) in India. Main Runners shall be of 24mm wide, 38mm deep of 0.35mm thick inverted "Tee" sections of 3000mm long, with factory punched flanges to receive torsion spring assembly. Spacing of main Tee shall match panel length. Cross Runners shall be of 24mm wide, 32mm deep of 0.30mm thick cross runner sections of 1200mm long, inverted "Tee" sections designed to interlock in to web of main tee section on designated spacing. Cross tee length to match panel length. Cross tees are spaced at 1200mm cc. Suspension System shall hang through anchor fastener with the help of 6mm threaded rod of 1200mm will be suspended from true ceiling / sub structure. T- Grid holding bracket of width 15mm, length 60mm and height 25mm of 2mm thickness is fixed to threaded rod and then main-T is fastened to bracket. T – Grid holding bracket is acting as a leveling system.</p>

S.No.	Item	Description of Item
7.04	Mineral Fibre Ceiling Tiles as per finishing schedule	<p>It shall be 19 mm thick of size 595X595mm of approved texture, design and pattern. The tiles shall be confirming to ISO 4 according to norm ISO 14644-1:2015, having Humidity Resistance (RH) of $\geq 99\%$, $NRC \geq 0.7$, Light Reflectance 85-90%, thermal Conductivity $k = 0.052- 0.057$ w/m K, Fire Performance A2-s1.d0 with Anti- Bacterial coating, adhering to Clean room requirement of Class 100 as per US Fed Standard 209 E and wash ability requirement of 500 wash cycles as per ASTM 4828 and with Recycled content of minimum 70%. Tiles shall be suspended in true horizontal level on interlocking T-Grid of hot dipped all round galvanized iron section of 0.38 mm thick (galvanized @120 gsm) comprising of main T runners of 15x38 mm of length 3000 mm, cross T of size 15x38mm of length 1200 mm and secondary intermediate cross T of size 15x38 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised @80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod upto 1000 mm length and L-shape level adjuster of size 80x30x0.6 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size 24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. crews. The exposed bottom portion of all T-sections used in false ceiling support system shall be prepainted with polyester baked paint, for all heights.</p>
7.05	Calcium Silicate Board ceiling as per finishing schedule	<p>It shall be 8 mm thick Calcium Silicate Board made with Calcareous & Siliceous materials reinforced with cellulose fiber manufactured through autoclaving process, fixed on framework made of special section, power pressed from M.S. sheets and galvanised with zinc coating of 120 gms/ sqm (both side inclusive) as per IS : 277 and consisting of angle cleat of size 25mm wide x 1.6mm thick with flanges of 27mm and 37mm, at 1200mm c/c, one flange fixed to the ceiling with dash fastener 12.5mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25 x10 x0.50mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I channels 45 x15 x 0.90mm running at the spacing of 1200 mm c/c, to which the ceiling section 0.5mm thick bottom wedge of 80mm with tapered flanges of 26 mm each having lips of 10.5mm, at 450mm c/c, shall be fixed in a direction perpendicular to G.I intermediate channel with connecting clip made out of 2.64mm dia x 230mm long G.I wire at every junction, including fixing perimeter channels 0.50mm thick 27mm high having flanges of 20mm and 30mm long, the perimeter of ceiling fixed to wall/ partitions with the help of Rawl plugs at 450mm centre, with 25mm long dry wall screws @ 230mm interval, including fixing of Calcium Silicate Board to ceiling section and perimeter channels with the help of dry wall screws of size 3.5 x25mm at 230mm c/c, including jointing & finishing to a flush finish of tapered and square edges of the board with recommended jointing compounds, jointing tapes, finishing with jointing compounds in three layers covering up to 150mm on both sides of joints and two coats of primer suitable for boards, all as per manufacture's specification.</p>

S.No.	Item	Description of Item
7.06	Baffle Ceiling as per finishing schedule	<p>Baffle Ceiling System, comprises of baffle width of 50mm and height of 100mm manufactured out of 0.6mm thick Coil Coated Aluminium of alloy AA 3105 at a module of 200mm. The length of the panel shall be up to 2400mm. The sizes may be customized as per direction of Engineer-in-charge. Nothing extra shall be payable on this account. The baffle shall be manufactured on high speed, high precision roll forming machine to ensure the flatness and to avoid the failure of metal at corners which may occur normally on press brake machine. The coil is coated on a continuous paint line double baked and shall be stove enamelled in a continuous coil coating process of the approved colour on the exposed side and the reverse side with polyester primer. The U Baffle ceiling panels shall be mounted on coil coated customised Hat type Aluminium carrier of size 60mm x 30mm x 0.9mm thick. The customised carrier shall be suitable for both torsion spring based & standard fixed Baffle panels. The carrier shall be suspended with M6 Threaded rod hangers spaced at 1200mm c/c. At least 20% of the total ceiling area, shall be demountable torsion spring-based panels. The baffle ceiling system should meet the required standards for Green Pro certification and should qualify as green product.</p>
7.07	Wooden Slats ceiling as per finishing schedule	<p>Non FR made out of pinewood fibreboards, Melamine finish, perforated wooden grooved slats L8-2 - (2mm grooves @ 8mm centers) / L16-2 - (2mm Slats @16mm pitch) / L32-2 - (2mm grooves @ 32mm centres) /L64-2 - (2mm grooves @ 64mm centers), backlined with acoustical fleece, tongue-groove edge for a seamless look, FR grade, of lineal dimension size 128mmx 2440mm x 16mm thick having density 800Kg /m3, weight 10 Kgs/m2, shall be installed by using suspended ceiling system. The wooden slat shall have NRC ≥ 0.75, Light reflectance of 75%, Green (RC %) – 25, Hygiene category (VoC, Clean room) – Low Class 1, Antisag, resistant to Ball-Impact properties. The ceiling system shall include GI Wall channel(WC25) having thickness 0.45mm, length 3600mm, unequal flanges of 20 & 30mm and web of 25mm to be fixed along the perimeters of the wall with nylon sleeves and suitable fasteners at every 300mm centers. Suspended Main channels(MC45) having thickness 0.9mm, length 3600mm, equal flanges of 15mm and web 45mm from the soffit at every 1200mm centers with Suspender angle (SA25) having thickness 0.45mm, length 3600mm, unequal flanges of 25 & 10mm. GI Cross channel(CC25) having thickness 0.45mm, length 3600mm, knurled web of 50mm, depth of 25mm and equal flanges of 9.5mm is fastened to the Main channel (MC45) in the direction perpendicular to the Main Channel(MC45) at every 600mm centers. Aluminium core cross channel (CC18) having 0.5mm thick, 15mm & 27mm width, height 18mm, flanges of 7mm and length 2500mm is then fixed to the Cross channel (CC25) with the help of metal fasteners in direction perpendicular to the cross Channel at every 400mm centers. Slats of size 128mm x 2430mm x 16mm thick in then fixed perpendicular to CC18 with suitable edge & centre brackets.</p>

S.No.	Item	Description of Item
7.08	Channelled Flutes perforated panels as per finishing schedule	Channelled Flutes perforated panels of width 128mm, thickness of 16mm and length 2440 mm or as per finishing schedule or as per drawings or as decided by engineer in charge, made of a high density particle board substrate with a laminated facing as per the wooden / white finish and a woven fleece layer on the reverse side. The boards shall have a special perforation pattern where the visible surface has a "Helmholtz" fluted perforation of 4mm width and 28mm of visible panel each. The panels shall provide a minimum sag resistance of RH90 and a fire rating class of 1 as per Part 7 of BS 476. The edges of the panels shall be "tongue-and-grooved" to receive special clips for installation. The back of the perforated panel shall have Soundtex Make sound absorbing non-woven acoustical fleece. The panels shall be mounted on special aluminium splines using clips approved by the Engineer-in-Charge. INSTALLATION: Installation shall be with GI Section of 50mmx50mm or as approved by the Engineer-in-Charge on the solid wall/Ceiling horizontally using screws and plugs at spacing of 600mm centre-to-centre. Screw the aluminium extruded keel for Flutes (GTPT001) over the lowest and second GI Section at an on-center distance of 600mm. Install the first set of wooden panels by inserting the clips for border Flutes (GTPT002) and insert the groove of the panel into the projecting flange of the aluminium clip. Continue installing rows of panels by inserting the tongue into the groove of the earlier inserted panel and progressively installing clips for inside Flutes (GTPT003) into the next keel till the actual height is achieved. Use clips for border Flutes (GTPT002) to finish off the installation. Finish off the edges using wooden moulding of matching colour.
7.09	Aluminium grid Ceiling System as per finishing schedule	Aluminium grid Ceiling System shall be of 600x600 mm (perforated/non-perforated tiles made out of 0.7 mm thick aluminium sheet) having NRC of 0.7, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending and perforation. The system includes 'C' wall angle of size 20x30x20 mm made of 0.5 mm thick pre painted steel along the perimeter of the room with help of nylon sleeves and wooden screws at 300 mm center to centre, suspending the main C carrier of size 10x38x10 mm made of GI 0.7 mm thick from the soffit with help of soffit cleat 37x27x25x1.6 mm, rawl plugs of size 38x12 mm and C carrier suspension clip and main carrier bracket at 1000 mm c/c. Inverted triangle shaped Spring Tee having height of 24 mm and width of 34 mm made of GI 0.45 mm thick is then fixed to the main C carrier and in direction perpendicular to it at 600 mm centers with help of suspension brackets. Wherever the main C carrier and spring T have to join, C carrier and spring T connectors have to be used. All sections to be polyester powder coated (both side inclusive), fixing with clip in tiles into spring T.
8.00		FINISHING - PUTTY, POP, PAINTING, POLISHING
8.01		Internal finishing like painting, wall panelling, dado, shall be provided as per Finishing Schedule.
8.02	Putty	All the internal surfaces including exposed ceiling (non false ceiling areas) shall be finished with 1 mm thick cement based wall putty, one coat of cement primer and two or more coats of paints specified in finishing schedule.

S.No.	Item	Description of Item
8.03	White cement based putty over plaster	Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.
8.04	Anti-Bacterial Paint	Low VOC, highly washable, water based, abrasion resistant (over 4000 cycles) sanitizing and anti-bacterial coating Ultrasetin (D-11205) shall be applied as per finishing schedule to all kind of surface and enhancing protection against bacteria for Hygienic environment and conforming to JIS Z 2801:2100 test Protocols for Anti- Bacterial Coatings test. The material should be reactive curing acrylic resin water based coating. One coat of water based acrylic primer shall be applied before application of two coats of water based anti-bacterial coating.
8.05	synthetic enamel paint on steel work	All the steel work shall be applied two or more coats of synthetic enamel paint over a coat of suitable primer of approved brand and manufacture with ready mixed red oxide zinc chromatic on steel / iron works having VOC content less than 250 grams/litre.
8.06	Water repellent coat	2 to 3 coats of Silicone based water repellent, anti-algal paint of approved shade, complete as per manufacturer's specifications, shall be applied on stone cladding.
8.07	Ceiling and wall painting	Wall painting with premium acrylic emulsion paint of interior grade, having VOC (Volatile Organic Compound) content less than 50 grams/ litre of approved brand and manufacture, including applying additional coats wherever required to achieve even shade and colour. -Two coats or more coats
8.08	Melamine Polish	Melamine Polish shall be done (in 3 or more coats to achieve superior finish) on all teak wood & decorative veneered surfaces
9.00		STAINLESS STEEL WORK
9.01		Stainless steel of grade SS 304 grade railings shall be provided as per architectural design in staircases, steps, Ramps corridors and in other common circulation areas as indicated in drawings and in accordance with provisions of NBC 2016 as per Schedule.
9.02	Railings	Stainless steel railing shall be provided with SS 304 grade stainless steel of 50 mm dia. of 18 gauge handrail with adequate rods parallel to handrail, balusters, flanges, end caps, newel posts with caps etc. complete as per GFC drawings and direction of Engineer-in-charge.
9.03	Railings	Stainless steel railing, both sides in staircase and external ramp with double handrail shall be used for barrier free accessibility requirements with adequate SS balusters, runners etc. as per GFC architectural drawing.

S.No.	Item	Description of Item
9.04	Railing	Providing and fixing stainless steel (Grade 304) gates, railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners , stainless steel bolts etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in charge, including fixing accessories such as nuts, bolts, fasteners etc..
9.05	Braille Labels	Stainless Steel (Grade 304) Braille Labels of size 170mm x 35mm X 0.5 mm having Braille dots raised 0.5mm above base plate with one SS rivet of same grade and adhesive of approved make shall be provided on handrails.
9.06	Wall Guard Vinyl Snap Handrail	Handrail should be having rigid vinyl Snap-On cover (Lead Free) of 080" (2mm) thickness extruded from chemical and stain resistant Unplasticized Polyvinyl Chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added (Plasticizers may aid in bacterial growth). Surface shall have a pebblette texture for scratch and stain resistance with rigid vinyl cover mounted on a sturdy continuous Aluminium Retainer of .080" (2mm) thickness that shall be fabricated from 6063-T5 Aluminium with a mill finish. Dimensions to be 4-5/16" (110mm) height x 1-5/8" (41mm) Gripping Diameter, extends 3-1/8" (79mm) from wall which has an oval gripping surface. The system shall resist an Impact of 30.2 ft- lbs./inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics. The rigid vinyl shall not support fungal or bacterial growth in accordance with ASTM G-21 and G-22. The system shall also conform to class 'A' fire rating and ASTM D-543 for chemical and stain resistance. It includes Moulded end returns with black reveal strip and mounting brackets.
9.07	Corner Guard	Corner guard shall be provided invariably in all corridors, Lobbies, internal ramps.
9.08	Wall guard	Wall guard and handrails shall be provided at 750 mm from FFL or at height specified in drawings or conforming to relevant standards.
10.00		FAÇADE GLAZING AND CLADDING SYSTEM
10.01		External finishing including painting, cladding, structural glazing shall be provided as per Schedule / drawings. Shop drawings to confirm to that.
10.02		Windows along with glazing designed for wind loads applicable to the area / location as per relevant IS codes. Shop drawings to confirm to that.
10.03		Structural glazing / cladding system designed for applicable wind loads, thermal expansions and seismic movements. Shop drawings to confirm to that.
10.04		Aluminium louvers, shall be provided as per GFC drawings. The sections for fixing of such jalis shall be designed as per Codal provisions to withstand wind loads, seismic movements etc.

S.No.	Item	Description of Item
10.05	Aluminium sections for curtain wall glazing & structural glazing	Providing and supplying aluminium extruded tubular and other aluminium sections as per the architectural drawings and approved shop drawings , the aluminium quality as per grade 6063 T5 or T6 as per BS 1474,including super durable powder coating of 60-80 microns conforming to AAMA 2604 of required colour and shade as approved by the Engineer-in-Charge.
10.06	Fabricating, installation & testing of Curtain wall Glazing	Fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels, including:
10.07	Shop drawings of curtain wall glazing / structural glazing	(a) Structural analysis & design and preparation of shop drawings for the specified design loads conforming to IS 875 part III (the system must passed the proof test at 1.5 times design wind pressure without any failure), including functional design of the aluminium sections for fixing glazing panels of various thicknesses, aluminium cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc., structural and weather silicone sealants, flashings, fire stop (barrier)-cum-smoke seals, microwave cured EPDM gaskets for water tightness, pressure equalisation & drainage and protection against fire hazard including:
10.08	Brackets	(b) Fabricating and supplying serrated M.S. hot dip galvanised / Aluminium alloy of 6005 T5 brackets of required sizes, sections and profiles etc. to accommodate 3 Dimensional movement for achieving perfect verticality and fixing structural glazing system rigidly to the RCC/ masonry/structural steel framework of building structure using stainless steel anchor fasteners/ bolts, nylon separator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers.
10.09	Silicon sealant	(c) Providing and filling, two part pump filled, structural silicone sealant and one part weather silicone sealant compatible with the structural silicone sealant of required bite size in a clean and controlled factory / work shop environment, including double sided spacer tape, setting blocks and backer rod, all of approved grade, brand and manufacture, as per the approved sealant design, within and all around the perimeter for holding glass.
	Flashing	(d) Providing and fixing in position flashings of solid aluminium sheet 1 mm thick and of sizes, shapes and profiles, as required as per the site conditions, to seal the gap between the building structure and all its interfaces with curtain glazing to make it watertight.

S.No.	Item	Description of Item
	Provision for drainage	(e) Making provision for drainage of moisture/ water that enters the curtain glazing system to make it watertight, by incorporating principles of pressure equalization, providing suitable gutter profiles at bottom (if required), making necessary holes of required sizes and of required numbers etc. complete. This item includes cost of all inputs of labour for fabricating and installation of aluminium grid, installation of glazed units, T&P, scaffolding and other incidental charges including wastages etc., enabling temporary structures and services, cranes or cradles etc. as described above and as specified. The item includes getting all the structural and functional design including shop drawings checked by a structural designer, dully approved by Engineer-in-charge. The item also includes the cost of all mock ups at site, cost of all samples of the individual components for testing in an approved laboratory, field tests on the assembled working structural glazing as specified, cleaning and protection till the handing over of the building for occupation. In the end, the Contractor shall provide a water tight structural glazing having all the performance characteristics etc. all complete as required, as per the Architectural drawings, as per item description, as specified, as per the approved shop drawings and as directed by the Engineer- in-Charge.
		Note:- 1. Providing extruded aluminium frames, shadow boxes, extruded aluminium section capping for fixing in the grooves of the curtain glazing and vermin proof stainless steel wire mesh.
	Testing of structural glazing system	Note:-2. The following performance test are to be conducted on structural glazing system if area of structural glazing from the certified laboratories accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories), Department of Science & Technologies, India.
	Air leakage test	1. Performance Laboratory Test for Air Leakage Test (-50pa to -300pa) & (+50pa to +300pa) as per ASTM E-283-04 testing method for a range of testing limit 1 to 200 mVhr
	Water penetration test	2. Static Water Penetration Test. (50pa to 1500pa) as per ASTM E-331-09 testing method for a range up to 2000 ml.
	corner guard and hand rails shall be provided invariably in all corridors, Lobbies, internal ramps.	3. Dynamic Water Penetration (50pa to 1500pa) as per AAMA 501.01- 05 testing method for a range upto 2000 ml
	Static air pressure test	4. Structural Performance Deflection and deformation by static air pressure test (1.5 times design wind pressure without any failure) as per ASTM E-330-10 testing method for a range upto 50 mm
	Seismic Movement Test	5. Seismic Movement Test (upto 30 mm) as per AAMA 501.4-09 testing method for Qualitative test, Tests to be conducted on site.
	Water Leakage Test	6. Onsite Test for Water Leakage for a pressure range 50 kpa to 240 kpa (35psi) upto 2000 ml

S.No.	Item	Description of Item
10.10	Insulated glazed units for structural and curtain wall glazing	<p>Providing, assembling and supplying vision glass panels (IGUs) comprising of hermetically-sealed 6-16- 6 mm insulated glass (double glazed) vision panel units of size and shape as required and specified, comprising of an outer heat strengthened float glass 6mm thick, of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade, an inner Heat strengthened clear float glass 6mm thick, spacer tube 16mm wide, desiccants, including primary seal and secondary seal (structural silicone sealant) etc. all complete for the required performances, as per the Architectural drawings, as per the approved shop drawings, as specified and as directed by the Engineer-in-Charge. The IGUs shall be assembled in the factory/ workshop of the glass processor.</p> <p>(i) Coloured tinted float glass 6mm thick substrate with reflective soft coating on face # 2, + 16mm Airgap + 6mm Heat Strengthened clear Glass of approved make having properties as visible Light transmittance (VLT) of 25 to 35 %, Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25-0.28) and U value of 3.0 to 3.3 W/m² degree K etc. The properties of performance glass shall be decided by technical sanctioning authority as per the site requirement.</p>
10.11	Openable shutters in glazing	<p>Openable side / top hung vision glass panels (IGUs) including providing and supplying at site all accessories and hardware's for the openable panels as specified and of the approved make such as heavy duty stainless steel friction hinges, min 4 -point cremone locking sets with stainless steel plates, handles, buffers etc. including necessary stainless steel screws/ fasteners, nuts, bolts, washers etc. all complete as per the Architectural drawings, as per the approved shop drawings, as specified and as directed by the Engineer- in-Charge.</p>
10.12	Shadow Box	<p>Providing, fabricating and supplying shadow box of required size and shape, for fixing in the spandrel portion of the structural glazing, in linear as well as curvilinear portions of the building by providing semi-rigid, inorganic, non- combustible fibre glass wool insulation 50 mm thick, conforming to IS: 8183 and BS: 3958 Part 5. The insulation layer shall have facing (factory bonded on surface # 1 of the fibre glass insulation layer), of black non-woven fibre glass tissue of nominal thickness 0.5 mm and nominal mass not less than 60 gm / sqm, made of randomly oriented glass fibres distributed in a binder by a wet- lay process including fixing 1.5 mm thick solid aluminium sheet backing using, 6 mm thick cement board including SS rivets, nuts, bolts, washers etc complete.</p>
10.13	Spandrel Glass Panels	<p>Providing and supplying Spandrel Glass Panels comprising of 6 mm thick heat strengthened monolithic float glass of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade so as to match the colour and shade of the IGUs in the vision panels etc. ,all complete for the required performances as specified, as per the Architectural drawings, as per the approved shop drawings, as specified, and as directed by the Engineer- in-Charge.</p>

S.No.	Item	Description of Item
10.14	External walls, sills, copings cladding of Hospital & R & D Block	Large format Porcelain tiles cladding 1200x2400mm size 6mm thick installed on natural aluminium box / tube 25mm x 40mm and 1.6mm thick sub frame works, L angle 38mm x 38mm x 2mm at corners as cleats, vertical grid pattern, stiffeners 25mm x 25mm x 1.6mm aluminium tube, structural sealant applied to stick the tiles, (Dow corning or equivalent make), weatherproof silicon filling in the joints, making tape, cleaning tiles with cleaner, double tape, screws etc complete.
10.15	Tinted Glass panels	6mm thick Tinted glass panels in aluminium glazing in hospital OPD
11.00		WATER PROOFING & INSULATION WORK
11.01		Waterproofing treatment shall be done as applicable and as required on terraces, sunken slabs, toilet slabs, lift pits, rafts & walls, water tanks, UG sumps, OHTs and any other liquid retaining structures as per Schedule. Water stops shall be provided in construction joints of liquid retaining structures.
11.02	Waterproofing	Basically in all the buildings all the RCC works below plinth level (foundations, columns, slabs, shear walls, retaining walls, beams, lift well etc.), RCC work in Terrace slab (Columns above it, if any), retaining walls (with or without weep holes), reservoir, U.G. Tanks, water retaining/carrying structures, sewage & water treatment plant etc.) shall be given waterproofing treatment by adding the cementitious integral crystalline admixture @0.80% (minimum) to the weight of cement content per cubic meter of concrete) or higher as recommended by the manufacturer's specification in reinforced cement concrete at site of work. The material shall meet the requirements as specified in ACI-212-3R-2010 i.e. by reducing permeability of concrete by more than 90%, compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure. The crystalline admixture shall be capable of self-healing of cracks up to a width of 0.50mm.
11.06	Protection concrete over waterproofing	The treatment should be followed by protective layer of average 75 mm thick concrete screed (grade M-15) including control joints of 3M X 4M size and making angle fillet of 50mmX50mm using concrete at the corners.
11.07	Waterproofing of sunken areas	Water proofing treatment to vertical and horizontal surfaces in all internal wet areas of building (e.g. Toilets/Kitchens/AHU/balconies etc.) shall consist application of water based, anti-root, low VOC, single component, pure PU Polyurethane elastomer water proofing membrane with 1.5 mm DFT, having solid % value > 90, tensile strength > 2 mpa, Elongation > 550%, shore 'A' hardness 60 ± 5 with a 150 gsm polyester geotextile membrane. The system includes base preparation of cleaning, brushing and removal of flaky materials, grouting the porous area with cementitious grout, proper covering between slab and wall junctions and priming the surface as per manufacturer's specification. The coating shall be continued to the entire horizontal area and should be terminated at 300mm above the floor finish level complete as per manufacturer's specification.

S.No.	Item	Description of Item
11.08	Protection screed over waterproofing	The treated horizontal surface shall be provided 40 mm (minimum) concrete screed (Grade M-15).
11.09	Protection plaster over vertical waterproofing	The Vertical surface shall be provided with 15 mm thick Protective mortar of (1 Cement: 4 Coarse Sand) mixed with integral waterproofing compound of approved make as per manufacturer's specifications.
11.10	Brick bat Coba waterproofing treatment at top terrace of building	<p>Brick bat Coba - Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations: (a) Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment. (b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs.</p> <p>(c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge. (d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep. With average thickness of 120 mm and minimum thickness at khurra as 65 mm. (e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. "All above operations to be done in order and as directed and specified by the Engineer-in-Charge.</p>
12.00		TOILET CUBICLES, BLINDS
12.01	Toilet Cubical	Toilet Cubical shall be provided for all the internal doors of wet areas having more than one unit of W/C, bathroom, change rooms etc. in Hospital and Academic cum R&D buildings and Nurse Hostel.

S.No.	Item	Description of Item
12.02	Toilet Cubical	<p>Toilet cubical shall be of 12mm thick compact board with standard height of 1995mm and 600mm door size width made up of thermosetting resin treated high pressure, self-supporting decorative compact laminates with permanently incorporating anti-bacterial agents during manufacturing. Compact board should be Moisture resistant, Impact resistant, termite resistant, Scratch resistant, Weather and climatic shock resistant. Compact board should satisfy criteria of FSC and green guard gold certification. It should be manufactured under IS2046 and EN438-2&3:2005 standard and shall have resistance to water immersion through permissible increase on thickness and mass <0.60% and board density >1.35kg/cm³. Finish of compact laminates should be suede finish which includes door, pilasters and intermediate panels finished with approved texture/shades as per IS2046 and fulfilled the criteria of fire retardant under BS-476/97 and EN438-6 with classification of BS1D0 standard. Pilaster to be supported with SS (grade316) adjustable foot and intermediate panels will be attached to the wall with the help of approved SS (grade316) channels and all required hardware, made up of stainless steel as per manufacturer's specification. All required hardware (e.g. Door knob, gravity hinges, Thumb turn locksets with occupancy indicators ,coat hooks with door stopper , U channel, top rail with corner connector, adjustable foot/pedestal, Rubber noise deafening tape, screw & wall plugs) shall be approved by Engineer-in-Charge. The top fitting should consist of SS round top rail which will get fixed with pilaster, with SS panel tube holder ,SS corner bend (connected with top rail) will be use in corner of cubical in absence of brick wall, SS wall fixing is used only on the wall which will hold the SS top rail. All screw will be of 304 grade in SS with stain finish. All pilasters are supported by SS bottom cladding. The base of the stainless steel bottom cladding will be anchored to the floor with a clearance height upto 150 mm for European W/C whereas no clearance from floor shall be kept for Indian W/C. Finish and colour of Toilet cubical should be approved under guidance of Engineer-in-Charge.</p>
13.01	Blinds	<p>Blinds vertical / horizontal / roller of approved make and opacity shall be provided at windows at as per Schedule.</p>
13.02	Roller Blinds	<p>Roller Blinds shall be provided of approved make and approved shades having 0.40mm thickness in 100% polyester material with 100% Degree of opacity & having Weight of 375gm/Sqm to 450gm/Sqm in all sizes and for all Heights complete as per the direction of Engineer in Charge.</p>
13.03	Curtain rods stop ends in residences / guest house	<p>Curtain rods with stop ends of Stainless steel shall be provided at external windows.</p>

S.No.	Item	Description of Item
14		WALL GUARD / CORNER GUARD
14.05	Wall guard	The wall guard should be superior impact resistance wall guard vinyl (Lead free) Snap on cover of 0.080" (2mm) thickness extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth). Surface shall have a pebblette texture for scratch and stain resistance mounting on continuous aluminium retainer of 0.080"(2mm) thickness shall be fabricated from 6063-T5 aluminium, with a mill finish having dimensions of 6"(152mm) height x 1"(25mm) depth. Inner snap- on vinyl impact black bumper should be of 0.080" (2mm) thickness x 3.930" (100mm) width x 21mm height, which shall be extruded from chemical and stain resistant plasticized polyvinyl chloride (uPVC). The system shall resist an impact of 45.5 ft-lbs./inch while producing no visual blemishes upon vinyl cover surface and no deformation in the aluminium retainers, as tested in accordance with applicable provision of ASTM F 476-84 for Impact test and shall not support fungal or bacterial growth in accordance with ASTM G-21 and G-22. The system shall also confirm to class 'A' fire rating and ASTM D-543 for chemical and stain resistance. It shall include injection moulded and end caps with black reveal strip.
14.06	Corner guard	Corner guards shall be provided at every corner. Corner guard should be having Vinyl Snap on cover (Lead Free) of .080" (2mm) thickness extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth). Surface shall have a Pebblette texture for scratch resistance and stain resistance and shall be mounted on continuous Aluminium Retainer of .070" thickness fabricated from 6063-T5 aluminium, with a mill finish. Dimensions to be of 3" (76mm) x 3" (76mm),90 degree. The rigid vinyl profile shall resist an Impact Strength of 30.2 ft lbs /inch as per ASTM D-256-90b and shall not support fungal or bacterial growth in accordance with ASTM G-21 and G-22. The system shall also conform to class 'A' fire rating and ASTM D-543 for chemical and stain resistance. It includes Top caps and bottom caps which shall be made of injection moulded thermoplastics.
14.07	Cubical track system	Providing and fixing / installation of hospital cubical track system with following specifications: Track material shall in general be aluminium alloy 6063-T-6 having tensile strength 195 Mpa, shear strength 150 Mpa. All materials shall be corrosion-resistant and shall have minimum 50 micron polyester powder coating of approved shade. Hospital cubical curtains shall consist of anti-microbial polyester blended fabric with 450 mm nylon mesh (net) on the top of curtain. The fabric shall be specially coated with anti-microbial coating and shall be wrinkle free, shrink-proof, anti-odour, anti-fungal and stain-repellent. Curtains shall be fitted with stainless steel grommets at 150 mm centres. Anti-microbial quality of fabric shall be tested by AATC-147-2004 method (Qualitative method). The shade and design shall be decided by the Engineer in charge.
14.09	Mirrors	Providing of viewing mirror glass shall be made as per GFC drawings.
15.00		CABINETS AND FURNITURE

S.No.	Item	Description of Item
15.01	Cabinets	Cupboards, wardrobe in Bed rooms shall be provided as per Schedule / drawings
15.02	Cabinets	Kitchen cabinets / modular kitchen in kitchen shall be provided as per Schedule / drawings
16.00		SHAFTS
16.01	Shafts	All shafts (Civil and E&M) shall be appropriately closed horizontally and covered with appropriate door system vertically. This arrangement may be augmented as per fire requirements.
16.02	Shafts	GFRC (Glass fibre reinforced concrete) / WPC (Wood Polymer Composite) / CNC curtain jalis to cover exposed Rain water pipe shafts, Toilet shafts and other areas shall be provided as per requirement. The sections for fixing of such jalis shall be designed as per Codal provisions to withstand wind loads, seismic movements etc. as per Schedule.

PARTICULAR SPECIFICATIONS – STRUCTURE & CIVIL WORKS

STRUCTURE WORKS

1.0 GENERAL

1.1 Scope

This specification applies to the Civil, Structural and Civil Finishing Works to be executed by the Contractor. It is to be read in conjunction with and subject to the general conditions of contract and in conjunction with the drawings, the schedule of rates and such other documents as may from time to time be agreed upon as comprising part of this contract. Where these specifications are not clear, relevant BIS codes and CPWD specifications shall be followed with prior permission of Engineer-in-charge.

1.2 Clearing

The contractor shall clear the site of all rubbish, remove all grass and low vegetation and remove all bush wood, trees, stumps of trees, and other vegetation only after consultation with the Engineer-in-charge as to which bushes and trees shall be saved. All disused foundations, drains or other obstructions met with during excavation shall be dug out and cleared.

1.3 Site Levels

Refer level sheets and GFC drawings.

1.4 Bench-marks

Prior to commencement of construction, the contractor shall in consultation with the Engineer-in-charge, establish several site datum bench-marks, their number depending on the extent of the site. The bench-marks shall be sited and constructed so as to be undisturbed throughout the period of construction.

1.5 Setting out the work

The contractor shall set out the works and during the progress of the building shall amend at his own cost any errors arising from inaccurate setting out.

During the execution of the work contractor must cross check his work with the drawings. The contractor shall be responsible for all the errors in this connection and shall have to rectify all defects and/or errors at his own cost, failing which the Engineer-in-charge reserves the right to get the same rectified at the risk and cost of the contractor.

2.0 SITE DEVELOPMENT AND EARTH WORK

2.1 General

This specification deals with the clearance of the Site of Works and preparation of the same to commence the proposed construction activities. Wherever applicable, this is deemed to include all preliminary works like, Site Clearance, General Levelling etc.

The contractor shall visit the site, inspect the same and decide for himself the nature of the ground and the sub-soil to be excavated. No claim on account of extras will be entertained in consequences of any misunderstanding or incorrect information or ignorance of the existing conditions.

2.2. Shoring/Earth work

2.2.1 The contractor shall shore and strut the sides of excavation to the satisfaction of the Engineer-in-charge. Should there be any slips or settlement, notwithstanding the shoring, the contractor shall make good the same at his own expense, with concrete or other approved material, as

directed by the Engineer-in-charge. Shoring shall be removed gradually side by side with backfilling to prevent any settlement and under no circumstances, until such time as the foundation concrete has hardened enough, to take any loads brought on by the removal. Under special circumstances, shoring shall be left in place, if so directed by the Engineer-in-charge. No extra payment shall be made for shoring.

2.2.2 Dewatering

All excavation shall be kept free from water from any source. The contractor shall provide and clear away on completion, all drains, pumps and other equipment, for this purpose. The contractor shall be responsible for preventing any subsidence of adjoining ground due to pumping.

Contractor shall keep site dewatered till all construction works in underground and all other areas are completed, including waterproofing. No extra amount shall be claimed by the contractor on this account and his quoted rates shall be deemed to have been included for total dewatering.

2.2.3 Contractor to keep excavation clear

Should any sand, mud, weed, rubbish or other materials be deposited on excavated area, by sandstorm, rain, flood, landslips or from any cause, whatsoever, such materials shall be removed by the contractor at his own expense.

2.2.4 Back filling

All materials used as fill shall be to the Engineer-in-charge's approval and shall be well consolidated in layers not more than 200 mm thick. Final compacting must be done just before concrete is to be laid.

All fill materials shall be compacted at a moisture content appropriate to the material being used. The compacted filling shall achieve a density, which shall not be less than 95% of the maximum dry density obtained. Filling shall be free of any wood, organic matter or any other deleterious material.

Sand, soil, gravel etc. from the excavation may be used for backfilling of pits and trenches or for making up levels subject to approval of the Engineer-in-charge and subject to selection of proper materials. The contractor shall take instructions of the Engineer-in-charge regarding the location in which each type of excavated material is to be used according to its quality.

In case the excavated materials are not approved for backfilling, either totally or in part or if their quantity falls short of the quantity required for filling, suitable materials shall be brought to site from an approved source.

2.2.5 Disposal of surplus

Surplus excavated materials and all excavated materials rejected for backfilling, shall be carted away from the site by the Contractor.

2.3 Excavation in all Soils

Excavation and/or removal of any other material on the site, shall be carried out accurately to the lines, levels and dimensions shown in the drawings or as ordered by the Engineer-in-charge, so as to allow proper and efficient concrete work and other work in clean and dry condition. The method of excavation shall be at the discretion of the Engineer-in-charge but should the dimensions of any excavation exceed those shown on the drawings or ordered by the Engineer-in-charge or should the sides collapse, the contractor shall fill such extra space with concrete or other approved material, at his own expenses.

All founding levels will be inspected by the Engineer-in-charge and suitability for bearing of the bottom shall be determined before the concrete is placed. Records of all foundation levels shall be submitted by the contractor to the Engineer-in-charge.

The final 150 mm depth of excavation shall be taken out by hand unless otherwise permitted by the Engineer-in-charge. Extra depth of excavation, if any, beyond those shown in the drawings or ordered by the Engineer-in-charge, shall be filled up with M-10 / 1:3:6 concrete for which payment shall not be made to the contractor.

The contractor shall excavate any soft patches or rock outcrops below the founding level and refill with M-10 / 1:3:6 concrete. The founding stratum shall be trimmed to required level and rammed to the satisfaction of the Engineer-in-charge before concrete is placed.

Foundations within any one building shall not rest on soil strata with differential bearing capacities. Strip foundations shall not be stepped along the length of the foundations. When excavating for individual footings at different levels care shall be taken not to disturb the bearing stratum of the higher foundations. The excavation bottom shall be watered as directed by the Engineer-in-charge before the foundations are laid.

2.4 **Sweet Earth**

The Sweet earth for plantation areas, shall be from an approved source and shall be mixed with natural or artificial manure, as directed by the Engineer-in-charge.

2.5 **Pre-construction Anti-termite treatment**

i) **Chemicals**

The chemicals used for the soil treatment shall be any one or a combination of the following with concentration shown against each in adequate emulsion:

Chemicals (EC's)	Concentration
Chlorpyrifos / Landane	20% EC by weight

Chemicals are available in concentrated form in the market and concentration is indicated on the sealed containers. To achieve the percentage of concentration specified above, chemical should be diluted with water in required quantity before it is used. Graduated containers shall be used for dilution of chemical with water in the required proportion to achieve the desired percentage of concentration. e.g. to dilute chemical of 30% concentration, add 59 parts of water to one part of chemical to achieve 0.5% concentration.

Chemical shall be brought to site of work in sealed original containers. The material shall be brought in at a time in adequate quantity to suffice for the whole or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-charge. The empties shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from Engineer-in-charge.

Hand operated pressure pump shall be used to carry out spraying operations to facilitate proper penetration of chemicals in the earth. To have proper check for uniform spraying of chemical, graduated containers shall be used. Proper check should be kept that the specified quantity of chemical is used for the required area during the operation.

ii) **Time of application**

Soil treatment should start when foundation trenches and pits are ready to take mass concrete in foundations. Laying of mass concrete should start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it

is raining or soil is wet with rain or sub-soil water. The foregoing applies also in the case of treatment to the filled earth surface with the plinth before laying the sub grade for the floor.

The treated soil barrier shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

iii) **Treatment for masonry foundation and underground structures**

The bottom surface and sides (up to a height of 30 cm. from the bottom) of the excavations made for masonry foundations and underground structures shall be treated with the chemical emulsion mentioned above at 5 Ltrs. per Sq.m. of surface area.

iv) **Treatment to backfill earth**

After the masonry foundations and retaining walls of the underground structures come up, the back fill in immediate contact with the foundation structure shall be treated with the chemical emulsion at the rate of 7.5 Ltrs. per Sq.m. of the vertical surface of the sub-structure for each side. The earth is usually returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surface of the columns and walls so that the earth in contact with these surfaces is well treated with the chemical.

v) **Treatment for RCC foundations and underground structures**

The treatment described in (iii) & (iv) above applies essentially to masonry foundations where there are voids in the masonry through which termites can seek entry in to the superstructure. Hence the foundation requires to be completely enveloped by a chemical barrier. In the case of RCC foundations the concrete is dense being a 1:1.5:3 mix or richer, the termites are unable to penetrate it. It is therefore unnecessary to start the treatment from the bottom of excavations. The treatment shall start at a depth of 50 cm. below the ground level except when ground level is raised or lowered by filling or cutting after the foundations have been cast. In such cases the depth of 50 cm shall be determined from the new soil level resulting from filling or cutting mentioned above and soil in immediate contact with the vertical surface of RCC foundations. From this depth, the back fill around the columns, beams and RCC underground walls shall be treated at the rate of 7.5 Ltrs. per Sq.m. The other details of the treatment shall be as laid down in (iv) above.

vi) **Treatment of top surface of plinth filling**

The top surface of the consolidated earth within the walls shall be treated with the chemical emulsion at the rate of 5 Ltrs. per sq.m. of the surface before the sand bed or sub-grade is laid. If the filled earth has been well rammed and the surface does not allow the emulsion to seep through, holes up to 50 to 75 mm deep at 150 mm centres both ways may be made with 12 mm dia MS rod on the surface to facilitate absorption of the emulsion.

vii) **Treatment at junction of walls and floor**

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from the ground level (where it has stopped with the treatment described in (iv) above up to the level of the filled earth surface. To achieve this, a small channel 3 x 3 cm shall be made at all the junctions of wall and columns with the floor (before laying the subgrade)

and rod holes made in the channel up to the ground level 15 cm. apart and the rod moved back ward and forward to break up the earth and chemical emulsion poured along the channel at the rate of 7.5 Ltrs. per Sq.m. of the vertical wall or column surface of the sub structure so as to soak the soil right to the bottom. The soil should be tamped back in to place after this operation.

- viii) **Treatment to soil along external perimeter of building**
After the building is complete, the earth along the external perimeter of the building should be roded at intervals of 15 cm. and to a depth of 30 cm. The rods should be moved back ward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall at the rate of 7.5 Ltrs. per Sq.m. of vertical surfaces. After the treatment, the earth should be tamped back in to place. Should the earth outside the building be graded on completion of building, this treatment should be carried out on the completion of such grading. In the event of filling being more than 30 cm., the external perimeter treatment shall extend to the full depth of filling up to the ground level so as to ensure continuity of the chemical barrier.
- ix) **Treatment for walls retaining soil above floor level**
Retaining walls like the underground walls or outer walls above the floor level retaining soil need to be protected by providing chemical barrier by treatment of retained soil in the immediate vicinity of the wall, so as to prevent entry of termites through the voids in masonry, cracks and crevices etc. above the floor level. The soil retained by the walls shall be treated at the rate of 7.5 Ltrs. per sq.m. of the vertical surface so as to effect a continuous outer chemical barrier in continuation of the one formed under (iii).
- x) **Treatment of soil under apron along external perimeter of building**
Top surface of the consolidated earth over which the apron is to be laid shall be treated with chemical emulsion @ 5 Ltrs. per Sq.m. of the vertical surface before the apron is laid. If consolidated earth does not allow emulsion to seep through, holes up to 50 to 75 mm deep at 150 mm centres both ways may be made with 12 mm dia mild steel rod on the surface to facilitate saturation of the soil with the chemical emulsion.
- xi) **Treatment of soil surrounding pipes, wastes and conduits**
When pipes, wastes and conduits enter the soil inside the area of the foundation, the soil surrounding the point of entry must be loosened around each such pipe waste or conduits for a distance of 15 cm. and up to a depth of 7.5 cm before the treatment is commenced. When they enter the soil external to the foundations, they shall be similarly treated unless they stand clear of the walls of the building by about 7.5 cm. for a distance of over 30 cm.
- xii) **Treatment for expansion joints**
Expansion joints at ground floor level are one of the biggest hazards for termite infestation. The soil beneath these joints should receive special attention when the treatment under (V) is carried out. This treatment should be supplemented by treating through the expansion joint after the sub-grade has been laid, at the rate of 2 Litre per linear metre.
- xiii) **Safety precautions**
All chemicals used for anti-termite treatment are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled as vapours or spray mists or swallowed. Person using or handling these chemicals should be warned of these dangers and advised that absorption through the skin is the most likely source of accidental poisoning. They should be cautioned to observe carefully the safety precautions given below:

These chemicals are usually brought to site in the form of emulsifiable concentrates. The containers should be clearly labelled and should be stored carefully so that children and pet cannot get at them. They should be kept securely closed.

Particular care should be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions should also be avoided. Workers should wear clean clothing and should

wash thoroughly with soap and water, especially before eating and smoking. In the event of severe contamination, clothing should be removed at once and the skin washed with soap and water. If chemicals splash in to the eyes they shall be flushed with plenty of soap and water and immediate medical attention should be sought.

The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. Flames should not be allowed during mixing.

Care should be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs, which serve as sources of drinking water.

xiv) **Spraying equipment**

A pressure pump shall be used to carry out spraying operations to facilitate proper penetration of chemicals in to the earth.

3.0 PLAIN AND REINFORCEMENT CEMENT CONCRETE WORKS

3.1 All concrete included in the works shall comply with the General requirements of this section of the specification except where those requirements are modified by the provisions of later Clauses relating to specialized uses for concrete in which case the requirements of those Clauses shall take precedence.

3.2 Quality Assurance Plans and Supervision :

A competent person shall be employed full time whose first duty will be to supervise all stages in the preparation and placing of the concrete. All test on materials, the making and testing of cubes and the maintenance and calibration of all mixing and measuring plant shall be carried out under his direct supervision in the presence of the Engineer-in-charge. Contractor shall set up a laboratory with all testing arrangement at site. On award of the work contractor shall submit their quality assurance plans, complete methodology & sequence of construction for all activities.

3.3 Materials

a) **Cement**

Cement shall in general comply the following specifications :-

i) **Types**

The cement used shall be ordinary Portland cement conforming to IS 8112 - 1989

(Latest revision) of grade 43/ IS 12269 - 2013 (Latest revision) with maximum fly ash content of 30 %, for all works except where specifically mentioned in the Drawings, Bill of Quantities, and/or directed by the Engineer-in-charge . PPC confirming to 1489 (Part I) - 1991 (Latest revision) can also be allowed without fly ash.

All cement shall be fresh when delivered. Cement shall be delivered in sound and properly secured bags or other packages ready for immediate use and shall be used direct from the bag. The contractor shall maintain for Engineer-in-charge' inspection a record of receipts and consumption of cement indicating the source, the age and the date of receipt of cement. Cement containing lumps which cannot be broken by a light touch of fingers shall not be used in the works. Admixtures shall not be used without written consent of the Engineer-in-charge.

ii) **Sources**

Cement shall be obtained from sources, which are approved by the Engineer-in-charge. Makes and sources of cement shall not be varied from those used for trial mixes; should a change be unavoidable the contractor shall submit his proposals for the prior approval of the Engineer-in-charge and then carry out new trial mixes unless otherwise directed by the Engineer-in-charge. Cement of different kinds shall not be mixed at any stage.

iii) **Manufacturers' Test Certificates for Cement**

The Contractor shall request the cement manufacturer to forward to his site office the Certificate of conformity in accordance with IS (Latest Revision), and he shall cause a copy to be supplied to the Engineer-in-charge within 48 hours of the arrival of the certificate, which shall not be later than 14 days from the day of delivery of the relevant consignment. The test certificate shall be related to the date of delivery at site of consignment. The frequency of deliveries shall be such as to ensure that no cement is more than 3 months old when used in the works.

iv) **Samples of Cement**

Samples of cement to be used in the works shall be deposited with the Engineer-in-charge for his approval together with a certificate stating the name and address of the Manufacturer, the name and address of the supplier from whom it was purchased. The Engineer-in-charge may from time to time take samples of the cement being used in the works for testing.

v) **Storage of Cement**

The contractor shall provide a proper separate weatherproof store building with raised floor for cement storage on the site and shall at all times protect the cement from damp or any other deleterious influences. Each consignment of cement shall be kept separately and the contractor shall be careful to ensure the consignments are used in the order in which they are received. Vertical stack shall not exceed 8 bags.

In case cement gets affected from damp or any other deleterious influence, such cement shall not be used for construction work.

b) **Aggregates**

i) Materials used as aggregates shall be obtained from a source known to produce aggregates satisfactory for concrete and shall be chemically inert, strong, hard, durable, of limited porosity and free from adhering's, coating, clay lumps, coal residues and organic or other impurities that may cause corrosion of reinforcement or may impair the strength or durability of the concrete. Aggregates shall be tested in accordance with the requirements of IS. 383 or IS. 516 and the results of such tests shall be as hereinafter specified, the percentages being by weight unless the context indicates otherwise.

ii) Fine aggregates shall be natural sand or sand derived by crushing material like gravel or stone and shall be free from coagulated lumps. Sand derived from stone unsuitable for coarse aggregates shall not be used as fine aggregates. The caustic soda test for organic impurities shall show a colour not deeper than that of the Standard solution. The amount of fine particles as ascertained by the Laboratory Sedimentation test shall not exceed 10% for crushed stones. The settling test for natural sand or crushed stone shall be made, and after being allowed to set in for three hours the thickness of the layer of silt deposited on the coarser material shall not exceed 8%.

The grading of a natural sand or crushed stone i.e. fine aggregates shall be such that not more than 5 (five) percent shall exceed 5 mm in size, not more than 10% shall

pass IS sieve No. 150 not less than 45% or more than 85% shall pass IS sieve No. 1.18 mm and not less than 25% or more than 60% shall pass IS Sieve No. 600 micron.

Only washed sand of quality and grading specified herein above shall be used. Admixture of sand obtained by crushing natural stone may be permitted by the Engineer-in-charge, provided the mixture satisfies the requirements for the fine aggregates here in above specified. But not more than one part of the sand obtained by crushing natural stone may be added to two parts of washed sand.

iii) **Coarse Aggregate**

Coarse Aggregates shall be crushed stone. The pieces shall be angular, rounded in shape and shall have granular or crystalline or smooth (but not glossy) non-powdery surface. Fragile, flaky and laminated pieces, and mica shall not be present.

The "Aggregates Crushing Value" shall not exceed 45%. The amount of fine particles occurring in a free state or as a loose adherent shall not exceed 1%. When determined by the laboratory sedimentation test, after twenty-four hours immersion in water. A previously dried sample of the coarse aggregates shall not have gained in weight more than 5%.

Size of coarse aggregate shall be maintained within tolerance limit of 2.5%.

The grading of coarse aggregate shall be such that not more than 5% shall be larger than 20 mm and not more 10% shall be smaller than 5 mm and not less than 25% or more than 55% shall be smaller than 10 mm.

Maximum size of coarse aggregate shall be of 20 mm unless otherwise noted.

The grading of coarse aggregate of nominal size of 40 mm shall be such that not more than 5% shall be larger than 40 mm and not more than 5% shall be smaller than 5 mm and not less than 10% or more than 35% shall be of 10 mm size.

Aggregate (Fine and Coarse) shall be thoroughly washed with clean water if so directed by the Engineer-in-charge.

Fragile, flaky and laminated pieces, and mica shall not be present. Aggregate should be free from fine holes and stone should not be weathered.

3.4 **Steel Reinforcement**

The reinforcement steel shall in general comply the following specifications with Fe 550 D, these specifications shall also be binding on the contractor.

Type

Steel for bar and fabric reinforcement shall conform to mild steel of tested quality conforming to IS. 432 (Latest), or high yield strength deformed bar conforming to IS. 1786 or 1139 (Latest) or as specified in the drawings. The steel shall be kept clean and free from pitting, loose rust, mill scale, oil, grease, earth, paint or any material which may impair the bond between the concrete and the reinforcement or which may cause corrosion of the reinforcement or deterioration of the concrete. Fabric reinforcement (IRC weld mesh or equivalent) shall be delivered to site in flat sheets only.

Storage of Reinforcement

Before and after bending, reinforcement shall be stored on raised racks in separate lots by size and type and protected from damage, contamination and the effects of the weather. For the purposes of identification each lot shall be marked plainly and securely by approved methods.

Fabrication

Fabrication shall be accurately done to the dimensions, spacing and minimum cover as per structural drawings. Spacers shall be of cement mortar (1:2) cubes however shall not be leaner than the approved design mix. Steel chairs, spacer bars shall be used in order to ensure accurate positioning of reinforcement. All joints in steel reinforcement shall be overlapped. The length of overlap for tension and compression joints in mild steel reinforcement above 16 mm diameter may be welded if permitted by the Engineer-in-charge in writing.

Mechanical Couplers

Parallel threaded Mechanical splice / couplers shall be used for vertical members, 20mm dia and above, conforming to IS code 16172:2023.

Welded Laps

Wherever specified, welded laps shall be provided. No payment shall be made to the contractor for welding as per Engineer-in-charge's requirements, if the same is necessitated due to the reasons attributable to the Contractor. The welding of bars shall be carried out as per IS: 2751-1979, IS:9417-1979. Before doing welding of bars at site, the contractor shall make minimum 3 joints and get them tested in an approved laboratory at his own cost. The following precautions shall be taken:

- a) If the cold twisted deformed bar has an untwisted end at lapping point, then this portion shall be cut off prior to welding.
- b) Bars shall be free from rust at joints to be welded.
- c) Bars shall be aligned and kept in proper axis in order to minimize crookedness in bar after welding.

3.5 Water

Type

Water for mixing concrete shall be clean and free from harmful material and comply with the requirements of Clause 5.4 of IS:456:latest.

Water shall be only from sources / bore wells approved by the Engineer-in-charge, and shall be used in a manner as directed by the Engineer-in-charge.

Testing of Water

Prior to the commencement of the works, or whenever there is a change in the source of supply or when directed by the Engineer-in-charge, the contractor shall arrange for samples of water, for mixing concrete, to be submitted to an independent Government authorised testing laboratory, acceptable to the Engineer-in-charge for tests to determine that the water complies with this specification and is satisfaction in all other respects for the manufacture of high-quality concrete.

3.6 Grades and Strength Requirements of Concrete

General

Concrete shall consist of the material described under previous sections, using separate coarse and fine aggregate in an appropriate combination determined in the course of the preparation of mix design described hereinafter. The overall grading shall be such as to produce a concrete of the specified quality, which will work readily in to position without segregation and without the use of excessive water. In the case of mass concrete or blinding concrete

specified by nominal mix the use of "all-in" (20 mm and down) aggregate may be approved by the Engineer-in-charge. No addition of water shall be made at site. It shall be a homogeneous mix before use at site.

Slump

Only specified quantity of water shall be added to the cement and aggregate during mixing to produce concrete having a sufficient workability to enable it to be well consolidated, to be worked in to the corners of the shuttering and around the reinforcement to give the specified surface finish, and to have the specified strength. Water cement ratio shall be maintained as per IS. 456-(latest) unless specified otherwise. When a suitable amount of water has been determined, the resulting consistency shall be maintained throughout the corresponding parts of the work and tests shall be conducted to ensure the maintenance of this consistency according to the standard method of test for consistencies of concrete (slump test).

In case of pump concrete, the slump & workability required for pumping the concrete shall be achieved by the contractor at his own cost. Nothing extra shall be paid for use of extra cement and / or plasticisers.

Concrete Grades

Grade of concrete used in the works shall be shown on the drawings or as directed by the Engineer-in-charge. Minimum cement contents shall be as per Is 456- (latest) or specified otherwise. The grade of concrete to be adopted in the construction shall be as follows:-

- a) For mud mat, lean concrete , mass filling the concrete mix will be nominal mix concrete of 1:4:8 , 1: 3:6 (Cement : Coarse sand : 20mm Down aggregates) grade as specified in the GFC drawings These mixes may be prepared using mechanical mixer.
- b) For all RCC works, concrete used will be controlled concrete with grade of concrete as per GFC drawings.

Approved admixtures may be used strictly as per IS 456-(latest) and nothing extra will be paid for the use of the same. Admixture used should not impair durability of concrete nor combine with constituents to form harmful compounds nor increase the risk of corrosion of reinforcement. Dosages of retarders , plasticisers and superplasticisers if used shall not exceed 0.5 , 1.0 and 2.0 percent respectively by weight of cementitious materials.

Mix Design

As the guarantor of quality of concrete used in the construction, contractor shall carryout mix design and the mix so designed shall be approved by the Engineer-in-charge, however approval by Engineer-in-charge shall not relive the contractor from his responsibility towards quality & sufficiency of design mixes. The mix shall be designed to produce the grade of concrete having workability and a characteristic strength as indicated in the drawings. The target mean strength of concrete mix should be equal to the characteristic strength plus 1.65 times the standard deviation as indicted below.

<u>GRADE OF CONCRETE</u>	<u>STANDARD DEVIATION (N/Sq mm)</u>
M10, M15	3.5
M20, M25	4.0
M30 to M50	5.0

Mix design shall be carried out as per SP-23 (Hand book concrete mixes) Proportion / Type of aggregates shall be made by trial in such a way so as to obtain dense possible concrete with required workability. All ingredients of concrete should be used by mass only. Contractor shall carry out the mix design and get it tested from the laboratory / Institution as per the instructions of Engineer-in-charge. Test report shall indicate

1. Workability Test of fresh concrete
2. Analysis of fresh concrete
3. Setting time of concrete < Initial setting time
Final setting time
4. Strength Test < 7 days
28 days
5. Cement Type

No substitutions in materials used on the work or alterations in the established proportions be made without additional test to show that the quality and strength of concrete are satisfactory. Design mix shall not be converted into volume mix under any circumstances.

3.7 Batching and Mixing

Only controlled design mix will be used for concrete with strength more or equal to M 10 / 1:3:6. Volume batching may be allowed (Using mechanical Mixers) for mixes up to M 10 , for these leaner mixes mass volume relationship shall be checked frequently to ensure specified grading is maintained.

For the production of controlled concrete contractor shall set up, on site, automatic microchip controlled batching plant of capacity 30Cum/Hr or more minimum 2 nos. as per the requirement, complete with silos / stock piles for cement and aggregates and D.G sets to be provided to have uninterrupted supply of concrete. The batching plant shall be tested and calibrated as per manufacturers manual and to the satisfaction of Engineer-in-charge, before starting the production of concrete, to provide uniform & consistent cement concrete mix conforming to approved mix design Batching / Mixing plant shall conform to the requirements of IS 4925 & 4926. Batching plant shall have facilities for pre-setting the quantities to be weighed with automatic cut off when the same is achieved and also shall be equipped with sensors to control water ratio as per moisture contents of aggregates. Printed reports of all the components of all the batches of concrete as separated by on line computer of batching plant, shall be presented to Engineer-in-charge for his approval and records. Cube samples from each batch shall be taken as per the requirement of IS 456-(latest), in the presence of Engineer-in-charge. Cubes shall be tested to record 7days & 28Days cube strength. Contractor shall be responsible for the quality of concrete which will be indicated as per the cube strength results at the end of 7days & 28days. However, 28days strength results will be treated as final. Contractor shall make his own trial mixes for different grade and submit the report of the final design mix to be adopted for different grades to Engineer-in-charge for his approval and records (Contractor shall take in cognisance while designing concrete mixes, time required for transporting and placing the cement concrete mix at final position). Contractor shall specify along its bid the type and make of the proposed batching plant with brief specifications. All the concrete shall be pumpable including column & wall. Contractor to make provision for adequate no. of pumps as required for horizontal & vertical concreting.

The accuracy of the measuring equipment should be within plus or minus 2% of the quantity of cement being measured and within plus or minus 3% of the quantity of aggregate , water , admixture being measured. All measuring equipment should be maintained in a clean, serviceable condition.

Mixing with mechanical mixer (for M20 or richer) will only be permitted in exceptional circumstances and then with the specific arrangement of the Engineer-in-charge. No water shall be added to mixed concrete other than the quantity of water allowed for in the mix design and incorporated in batching.

Concrete or mortar which has commenced to set shall not be remixed with additional water and in no circumstances shall such concrete or mortar be used in the work.

3.7 Ready mixed concrete plant

If the concrete is sourced from ready mixed concrete plant or from captive on site or off-site automatic batching and mixing plants, the concrete produced and supplied by ready mixed concrete plants shall be in accordance with IS 4926.

3.8 Concrete Admixtures & Plasticizers

Admixtures are materials added to the concrete before or during mixing with a view to modify one or more properties of concrete in plastic or hardened state. Concrete admixtures are proprietary items of manufacturers and shall be obtained from established manufacturers having proven track record, with Engineer-in-charge's approval.

3.9 Transporting Concrete

From batching plant concrete to the location of proposed construction shall be transported through transit mixers to concrete pumps only . Contractor shall specify the make & type and number of transit mixers to be deployed along with concrete pumps with their make , capacity . The path to be used by transit mixers will be strictly as per the instructions of Engineer-in-charge. From the transit mixers concrete shall be transported to the final floor level / position through pumping only .Concrete and mortar shall be transported speedily and deposited in its place in the works without contamination, loss of ingredients or segregation. Buckets of builder's hoist shall be large enough to contain an integral number of batches .No concrete shall be placed in the works until the contractors' proposed method of transporting concrete have been approved.

3.10 Concrete placement

General

Concrete, when deposited, shall have a temperature of not less than 5°C and not more than 40°C.

The concrete shall be placed in the positions and sequences indicated on the drawings, in this specification and/or as directed by the Engineer-in-charge.

Contractor shall give adequate notice to the Engineer-in-charge of his intention to concrete any section of the works.

Except where otherwise directed, concrete shall not be placed unless the representative of the Engineer-in-charge is present and has previously examined and approved the positioning, fixing and condition of the reinforcement or any other items to be embedded and the cleanliness, positioning and suitability of the concreting surface.

The concrete shall be deposited as nearly as possible in its final position. It shall be placed in such a manner as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork. It shall be brought up in horizontal layers not exceeding 450 mm in compacted thickness unless otherwise authorised or directed by Engineer-in-charge. Concrete shall not be placed simultaneously on each side of large horizontal specified or approved construction joints.

Shutters for walls or thin sections of considerable height shall be provided with openings or other devices that will facilitate the cleaning of the accumulation of hardened concrete on the shutters or on the metal reinforcement above the level of the concrete and the removal of concrete in the case of segregations.

Placing concrete in cold / hot weather

No concrete shall be mixed or placed while the ambient temperature is above 40-degree Celsius on a rising thermometer or below 5-degree Celsius on a falling thermometer. The contractor shall supply an accurate maximum and minimum thermometer and hang it in an approved position on the works. Aggregates that have been exposed to frost shall not be used until completely thawed. Concrete shall be maintained by approved means at a temperature of not less than 5-degree Celsius during placing, and for a period of three days thereafter. All concrete placed during cold weather or when a frost is predicated or is likely to occur or occurs contrary to expectation, shall be protected from freezing by approved means.

Placing of concrete in wet weather

Concrete shall not be mixed and or placed in rainy weather or when there is likelihood of impending heavy showers. If it becomes necessary to place concrete during rainy weather, the contractor shall provide adequate protection by means of tarpaulin or similar other water proof material to immediately cover fresh concrete to prevent rain falling over it. This protection shall be left on the concrete for a period of 24 hours after placing of concrete.

3.11 Concrete placement under water

Concrete placed under water shall be deposited through a tremie pipe the diameter of which shall be not less than 200 mm or 8 times the size of the largest aggregate used in the concrete mix.

The construction of and the method of handling the tremie pipes shall be approved by the Engineer-in-charge. The pipes shall be waterproof and sufficiently strong to withstand severe handling conditions and any joints must be sealed with adequate gaskets.

At the commencement of tremie work the bottom of the pipe shall be sealed before being lowered in to position. The seal shall only be broken by the concrete being placed. The concrete placed in contact with a horizontal construction joint shall have a lower proportion of coarse aggregate and a higher proportion of cement than the remainder of the concrete. The proportion shall be agreed with the Engineer-in-charge's Representative.

All underwater concrete shall be placed in still water within a cofferdam or formwork which shall extend above water level.

The proportions of the mixes shall be agreed in accordance with the strength and workability required by the specification. To allow for losses an addition of 10% of cement shall be added to mixes of concrete scheduled to be placed under water.

3.12 Maintenance of Plant and Equipment

The contractor shall keep Batching Plant, weigh batching machines, mixing machines, compressors, vibrators and other plant and equipment for concrete and mortar work clean, well maintained and adjusted and where appropriate, shall check the accuracy of the

measuring devices at regular intervals, all to the approval of the Engineer-in-charge's Representative. Mixer blades shall be replaced when worn down by 20 mm.

3.13 Night Work

Concrete shall not be mixed, placed, compacted or finished during the hours of darkness, except where necessary to complete a pour. However, concreting in darkness for these exceptions shall be only after obtaining the express permission in writing from the Engineer-in-charge's representative and in his presence only.

3.14 Compacting Concrete

The concrete shall be fully compacted throughout the full extent of the layer. It shall be thoroughly worked against the moulds, and around any reinforcement and other embedded items without displacing them, and in to corners of the moulds. Successive layers of the same lift shall be thoroughly worked together adjacent to the common face. The date of laying concrete shall be marked for curing and removal of form work.

Immersion vibrators shall be of approved type and shall have frequency of not less than 10000 oscillations per minute. They shall penetrate the full depth of the concrete to be vibrated and be immersed at sufficiency close spacing so that the whole volume of the concrete is satisfactorily and uniformly compacted.

Where the underlying layer is of fresh concrete, immersion vibrators shall also penetrate that layer to ensure homogeneity. Immersion vibrators shall be withdrawn slowly to prevent formation of voids. Vibrators shall not be used to work the concrete along the moulds or in such a way as to damage shuttering or other parts of the structure or to displace the reinforcement or other embedded items. Immersion vibrators shall only be operated by those who have received proper instruction and training in their use.

External vibrators shall be of approved type and shall have a frequency of not less than 3000 oscillations per minute. They shall be securely and rigidly clamped to the shuttering. External vibrators shall only be used on shuttering which is strong enough to withstand the vibration without displacement, distortion or other damage.

The contractor shall ensure that sufficient standby vibrators and ancillary equipment are available during concreting operations.

3.15 Quality Control

- i) In order to ensure that the quality of materials and the mix proportions are suitable for the particular grade of concrete required are so maintained, sampling and testing shall be carried out regularly during the course of the works.
- i) As frequently as the Engineer-in-charge's representative may require and, in any case, at least once a day while concreting is in progress, the contractor shall sample and carry out a determination of the moisture content and a mechanical analysis of the fine aggregate and each nominal size of coarse aggregate shall lie within the respective limits specified.
- iii) Workability testing shall be carried out in accordance with IS:456. The results shall lie within the range upon which the accepted mix design is based. Testing shall be carried out at such a frequency that the required workability is consistently achieved.
- iv) Samples of concrete shall be taken at random in accordance with IS: 516 at the time and place of deposition of the concrete.

- v) Notwithstanding the foregoing, additional samples shall be taken by the contractor when directed by the Engineer-in-charge. The test cube procedure shall be in accordance with IS: 516 throughout.
- vi) Compliance with the specified characteristic strength shall be assumed if :
 - a) Each of the six cubes in a group has a test strength not less than the characteristic strength or,
 - b) Not more than one cube has a test strength less than the specified characteristic strength but not less than 85% of the specified characteristic strength and the average strength of the group of four test results is not less than the specified characteristic strength plus the standard deviation of the group.

3.16 Seven-day cube tests

Acceptance of concrete is based on the 28th day results. However, the contractor shall establish a relationship between 7 days and 28 days strengths by carrying out 7 days tests at the time of performing the laboratory testing and from subsequent quality control testing. This relationship shall be used in interpreting any further test results to predict the probable value of the corresponding 28 days cube strengths. The contractor shall without delay advise the Engineer-in-charge of any sample that appears likely to fail to meet the specification and the contractor shall take any necessary action to minimize the effect of such failure.

3.17 Acceptance Criteria

The general Acceptance Criteria of any and all of the concrete work shall be as per the relevant Clauses of latest issue of IS. 456.

If any of the works tests are not up to the standard, the Engineer-in-charge shall have the power to stop the work until the reason is investigated and steps taken to prevent further low results. The contractor shall not be entitled to any claims on account of such delays. Any concrete carried out from the batch that is afterwards found to be faulty, will be liable for rejection and if so directed, the contractor shall at his own expenses dismantle and replace the defective work and any work built thereon or shall take such other measures as may be deemed necessary by the Engineer-in-charge. At the discretion of the Engineer-in-charge, the contractor may be allowed to prove by means of a load test to be carried out at his own expense, that the concrete is capable of safely withstanding the loads as specified in the test.

3.18 Construction joints

Construction joints shall be provided in the position described on the drawings or elsewhere and where not so described on the drawings or else shall be in accordance with the following:

-

- a) A joint shall be formed horizontally at the top of a foundation and 75 mm below the lowest soffit of the beams meeting at the head of a column.
- b) A joint shall be formed in the rib of a large tee beam and all beams 25 mm below the soffit of the slab.
- c) Concrete in a haunch or a splay on beam or a brace, and in the head of a column where one or more beams meet, shall be placed without a joint at the same time as that in the beam or beams or brace.

- d) Concrete in the splay at the junction of a wall and slab shall be placed throughout without a joint, but if the provisions of a joint are unavoidable, the joint shall be vertical and the middle of a span.
- e) A joint in a slab shall be vertical and parallel to the principal reinforcement, where it is unavoidable, at the right angles to the principal reinforcement, the joint shall be vertical and at the middle of the span.
- f) Expansion joints, hinges or other permanent structural joints shall be provided in the positions and of the form described in the drawings or elsewhere. Before placing new concrete against concrete that has already hardened the face of old concrete shall be cleaned and roughened and scrubbed and loose aggregate removed from the form. Immediately before placing the new concrete the face shall be thoroughly wetted and a coating of neat cement grout applied thereto. The new concrete shall be well rammed against the prepared face before the grout sets.

3.19 Form Work and scaffolding / Staging :-

Form work to the fresh concrete shall be sufficiently rigid and shall be such as to prevent loss of slurry from the concrete and details and design of the form work shall conform to IS 14687. The tolerances on the shape, lines and dimensions shall be as per CL. 11 of IS 456 -2000.

All staging and scaffolding work shall comprise of MS .Pipes / Structural steel sections with necessary coupling arrangement. (No wooden ballies / props will be permitted). Adequate size foundation blocks / base plates shall be provide below staging members to disperse the loads as per the founding strata.

Form work construction

- i) The contractor should submit detailed drawing of the centering & shuttering and get the same approved from the Engineer-in-charge before laying concrete also he should get the centering shuttering approved in writing before start of concreting. The concreting should be done in the scientific and methodical manner so as to give a uniform finish in line and level, so that minimum rendering or plastering is done. The work found defective, should be dismantled & redone and site cleared.
- ii) Form work shall be so constructed that concrete can be properly placed and thoroughly compacted. Form work shall be firmly supported and adequately strutted, braced or tied to maintain position and size . Forms shall have sufficient strength and rigidity to with stand the weight of wet concrete and necessary pressure due to ramming and vibration of concrete and movement of men material and other loads without excessive deflection from prescribed limits. It shall be capable of adjustment to the lines , levels and dimensions of the finished concrete.
- iii) All form work shall be constructed to be rigid during the casting of concrete and constructed so that the surfaces adjacent to the concrete are with plus minus 6 mm or the required surfaces when supporting the concrete and sufficiently watertight to prevent loss of liquid from the concrete, and it shall be capable of being removed without shock or vibration to the concrete. Forms shall be cleaned with compressed air immediately before placing concrete to remove all rubbish. The inside faces of the form work shall be treated with a mould oil of type to be approved by the Engineer-in-charge and every care shall be taken to prevent mould oil from getting on to the reinforcement.
- ii) Beams boxes shall be erected with an upward camber of 6 mm for each 3 M. of span.

- iii) Around the periphery of the building beyond building line, staging shall be erected by the contractor free of cost , using structural steel members duly braced to sustain all loads , with all safety measures like netting , temporary railings / parapets , platforms etc. to provide free access to external façade of the building at each floor level for construction and inspection. Staging shall grow along with the building .

Removal of Form work (Stripping Time)

Unless certainly specified in the drawing, or directed by the Engineer-in-charge, the following shall be minimum intervals of time, which should be allowed between the placing of the concrete and the stripping of the mould where ordinary Portland cement is used and ambient temperature does not fall below 15 degree Celsius.

- | | | |
|----|--|---|
| a) | Walls, column & vertical faces of all structural members | 16 to 24 hours as may be decided by the Engineer-in-charge. |
| b) | Slab | |
| | i) Spanning upto 4.50 m | 7 days |
| | ii) Spanning over 4.50 M | 14 days |

Note : Soffit forms of the slab may be removed after 3 days , props to be fixed immediately after removal of shuttering .

- | | | |
|----|-------------------------|---------|
| c) | Beams and arches | |
| | i) Spanning upto 6 M | 14 days |
| | ii) Spanning 6 M to 9 M | 21 days |
| | iii) Spanning over 9 M | 28 days |

Note:

1. For other types of cement, the stripping time recommended for ordinary Portland cement may be suitably modified. Forms shall not be released un till the concrete has achieved a strength of at least twice the stress to which concrete may be subjected to after removal of the form.
2. The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

However, the Contractor shall delay the removal of shuttering as long as necessary in order to avoid damaging the work. Where shuttering to soffit is removed prior to the props this is only permissible if the design of the shuttering allows such a sequence of operations without the props being in any way disturbed. If the shuttering and props are not independent, both must be left in place until propping is no longer required.

Where shuttering to sides is removed prior to the shuttering soffit, the side shuttering shall be removed without disturbing the shuttering to the soffit.

No concrete structure shall be loaded until the concrete is at least 21 days old and only then with the approval of the Engineer-in-charge and subject to such conditions as may be imposed.

The contractor may be required to produce evidence that the concrete has attained a strength sufficient to support the live and dead loads to which that part of the structure may be subjected. This evidence shall consist of reports of compression tests made on job cured test cubes. The cost of such tests shall be borne by the contractor. The foregoing provisions of this clause shall not relieve the Contractor of his responsibility to ensure that the stability and strength of any structure or part of a structure is not impaired by the release of shuttering.

Proposals for form work

Not less than 8 days before the contractor proposes to construct any form work his detailed proposals thereof shall be delivered to the Engineer-in-charge. Proposals shall comprise all relevant information including calculations, detailed drawings, rates of placing of concrete, sequence of placing of concrete and details of any external vibrators which are proposed to be used.

No form work shall be constructed until the Contractors' proposals have been received and approved by the Engineer-in-charge.

Type of form work

Two qualities of form work shall be used i.e. Rough form work and wrought form work, as noted on the Engineer-in-charge's drawings or described hereafter.

Rough form work may be constructed of sawn timber or other material as agreed by the Engineer-in-charge. The edges of the boards shall be planned or otherwise rendered grout tight. Provided it remain grout tight, rough formwork may be used any number of times. This form work shall be adopted for surfaces not exposed/buried needing no surface finish viz. Foundations/Pile caps.

Wrought form work, to all surfaces for which a smooth fair faced finish is required, shall be constructed of purpose-made metal, water proof ply wood panel, hardboard lined form work or of planed timber with edges shot so that tight joints can be formed which will prevent loss of liquid from the concrete. The use of a particular material for wrought form work shall be consistently maintained throughout the structure. The surfaces of the form work in contact with the concrete shall be smooth and free from all blemishes. The number of times wrought form work may be used shall be subject to the surfaces, joints and edges being clean and undamaged.

Surfaces of concrete

The contractor shall ensure that the finished face of concrete offers a suitable keyed surface for the application of the finishing media, e.g. plaster, sand and cement screed, etc. The contractor shall also ensure that where thin films of finished, e.g. skim coats "Snowcem", paint, etc. are to be applied that the previous provisions regarding supporting of form work are complied with, so that the concrete faces to be treated are left smooth, unblemished and true to line both vertically and horizontally and require no making good before applying the finish.

Should the contractor fail however, to comply with the provision of this Clause, he shall submit details of his proposed method of redoing the situation to the Engineer-in-charge and must obtain written consent from the Engineer-in-charge to the proposals before continuing with any further work on the affected surfaces.

Tolerances in concrete surfaces

The permissible tolerance in the surface of the hardened concrete shall not exceed the following limits :

Type of irregularity

Departure of member planes from position and level.	+	12 mm
Variation in cross-sections	+	6 mm
Sharp changes in plane	+	2 mm
Departure from 3 M. template of any part of planes	+	3 mm

3.20 Curing

Canvass, Hessian or other approved screens shall be erected at all points where concrete is being placed to shade the concrete from the direct sun or from drying winds and such screens

shall be kept in position until the surface of the concrete has been protected as specified in the following Clauses. The contractor shall be responsible for removing such screens and preparing surface of concrete.

As soon as possible after it has been placed and concrete shall be covered with Hessian or other approved material to protect it from the sun and all concrete surfaces shall be kept visibly wet continuously for 14 days after placement, the Hessian being kept in position throughout this period. Surfaces cast against forms shall also be kept moist and covered with Hessian for these periods if the form work is removed before the periods have elapsed.

The top surface of slab shall be kept flooded with water at all times till the curing period of 14 days is over. Columns, wall and beam sides and other surface shall be completely covered by gunny bags and kept thoroughly wet continuously for the period specified for curing. The ceiling of slabs shall be frequently sprayed with water until the end of curing period.

The contractor shall ensure that all times there is an adequate supply of fresh water available for curing the concrete.

Alternatively, curing compound of approved make & as per manufacturer be used.

3.21 Blank.

3.22 Fair face finish to concrete surfaces

Concrete surfaces shall be finished smooth fair faced where indicated as such on the drawings. These areas shall be entirely free from honey combing, stains, fins, lipping, nail or screw marks, raised grain marks, air holes or any other imperfections. They shall also be of even texture throughout. Very slight variations between member and member may be acceptable but any such variations within a single member cannot be tolerated. The concrete faces shall not be marked with mould oil.

The form work to these areas shall be wrought form work as specified herein.

Following inspection by the Engineer-in-charge the whole surface shall be rubbed down by hand. Any surfaces with major imperfections, i.e. greater than can be easily, completely and permanently obliterated by rubbing down shall be reported immediately to the Engineer-in-charge.

Remedial work is not normally possible to the above fair faced finish surfaces and the Contractor will be required to demolish and recast defective works.

3.23 Reinforcement Fabrication

Bending Schedules

The Contractor shall submit to the Engineer-in-charge, for the Engineer-in-charge's approval, bending schedule for all the works, not less than Ten days before the contractor intends to bend the reinforcing steel.

The Approval of the Engineer-in-charge shall in no way absolve the contractor of his responsibilities under the Contract.

Programme of reinforcement details required

The Contractor shall provide a programme which gives the Engineer-in-charge at least 28 days prior notification of any reinforcement details required. The contractor shall justify the

practicability of his programme to the Engineer-in-charge should it seem unreasonable before the programme be regarded as valid notification. If progress on site falls behind the contractors' programme, the issue of reinforcement details may be delayed by a period corresponding to the delay in construction.

Bending and placing reinforcement

Reinforcement shall be cut and bent to the shapes and dimensions shown on the finally agreed bending schedules in accordance with the requirements of IS: 2502 and to the tolerances set out therein.

Bending shall be carried out with an appliance which provides a continuous and uniform application of the bending deformation at every section of the bend. There shall be provision for the free movement of the surface of the bar during bending and the bends shall follow the contour of the former without peaking.

High Yield reinforcement must be bent without the application of artificial heating.

Mild steel reinforcement may be sent either hot or cold but shall not be heated to a temperature greater than 85⁰ C., and if heated not cooled by quenching.

Mild steel reinforcement temporary left projecting from the concrete at construction or other joints shall not be bent out of position unless shown on the drawings or agreed by the Engineer-in-charge. Where such bending and subsequent rebinding takes place the radius of the bend shall not be less than 4 bar diameters.

Reinforcement shall be fixed without forcing in the position shown on the drawings within a tolerance of 5 mm or 5% of the minimum dimension of cross section, whichever be the greater and maintained so that it is not displaced during concreting or other operations.

Horizontal bars shall be supported sufficiently to prevent displacement. This may be plastic spacers, chairs bent from steel bar, or by concrete blocks. The method and sufficiency of the support shall be subject to the approval of the Engineer-in-charge and no extra payment shall be made to the contractor.

Where concrete blocks are used, they shall be precast from concrete (not mortar) of the same class as the concrete in which they are to be embedded, except that the largest size of aggregate shall be 10 mm. Each block shall be secured to the reinforcement with wire or a clip embedded in the centre of the block so that, it shall not be in contact with the shuttering or subsequently cause rust marks on the concrete. Intersections of reinforcement shall be bound together with 20-gauge annealed GI binding wire.

Unless otherwise noted on the drawings, no intersections of reinforcement may be fixed by welding without the permission of the Engineer-in-charge. High yield and cold worked steel shall, in no circumstances, be welded together.

Should any difficulty arise during the placing of steel in obtaining the appropriate cover, the contractor shall immediately draw the attention of the Engineer-in-charge to the difficulty and shall carryout such corrective measures as the Engineer-in-charge may suggest.

Protection of reinforcement and concrete

The Contractor shall ensure that movement of men and material subsequent to steel fixing is organized so that reinforcement is not thereby displaced.

Reinforcement left projecting from any concrete shall be protected so that there is no risk of corrosion staining to any exposed concrete surface or to any other part of the works. For this

purpose, a stiff grout wash will normally be acceptable to the Engineer-in-charge, this wash shall be wire-brushed vigorously before further concrete is placed to remove any ill- bonded material.

3.24 Precast concrete units

Precast concrete materials and workmanship shall be in accordance with specifications unless indicated otherwise. Where different tolerances are indicated in this specification or on the drawings from these in the more severe tolerances shall apply. The units shall all be cast in properly made strong moulds to form the shapes required. For work described as "finished fair" the mould shall be lined with sheet steel or other approved material and care should be taken to ensure no damage is caused to edges or surfaces when units are removed from the moulds.

The concrete shall be of the mixes given on the drawings and shall be thoroughly vibrated in the moulds.

All precast work shall be cast under cover and shall so remain for seven days and shall be kept damp in order that the units are properly matured. No units shall be lifted until 18 days have elapsed since casting and no unit shall be erected until it has been approved by the Engineer-in-charge as free from defects.

No cracked units will be accepted for incorporation in the works.

All reinforced structural precast units shall have the tops clearly marked.

Un-reinforced precast units, such as sills and copings, shall be lightly reinforced as necessary to facilitate handling.

3.25 Rebar Resin Epoxy Chemical :

Resin Epoxy Chemical with Steel Rebar. The product should be approved by ETA, TR 069, ICC, CSTB, COLA, BZS with Shock approval, Seismic approval in Rebars to use in cracked/un-cracked concrete, tested for service temperature of -40deg C to +80 deg C. The chemical should have ETA for service life of 100 years and is to be tested for water tightness. The installation depth shall be supported by design based on EC2/TR069/ Rebar Design Method using Profis Rebar Software and approved by Structure Engineer- in charge. Drilling hole with double flute type drill bits/hollow drill bits to the required depth by rotary hammer drill, cleaning with brush and jet of clean air, filling resin and hardener using serrated nozzle to eliminate mixing error with standard HDE A12 battery dispenser along with piston plug and extension hose for longer depths to ensure no air bubbles are in the hole and then fixing with Rods, conducting occasional site inspection, executing work by trained personnel and occasional supervision from the manufacturer's representative in India. The installation and the setting instructions should be strictly followed as per the manufacturer's recommendations.

4.0 WATER PROOFING

4.1 General

It is the intent of this specification to secure a completely water tight underground, toilets and terraces etc. guaranteed for at least 10 (Ten) years from the date of final completion. The guarantee shall be executed & extended by the Contractor & not by the water proofing

agency. The contractor shall provide all materials, labour, plant, equipment, incidentals and everything necessary for securing a fully waterproof job as called for above.

All water proofing work shall be carried out by specialists as approved. Installation and materials shall be as per best practices for obtaining water proof work and as recommended by the manufacturer.

Water proofing work shall be commenced only after the surface is prepared, smooth rendered, cleaned free of dirt, dust and foreign matters, inspected and approved. Compressed air shall be used for effective cleaning of all surfaces. The vents and other projections through the roof shall be made absolutely secure before flashing.

Technical Specifications to be as per specialized vendor. All specifications to be got approved from structural consultants before start of water proofing works.

Technical supervision of the parent company for full time of execution of water proofing system at all level.

4.2 RETAINING WALL

Providing and laying of 1.5 mm thick SBS based self-adhesive waterproofing membrane topped with hdpe cross laminated film with the following technical properties-Softening point of 105 (oC) as per ASTM D36 ,Tensile Strength (L/T)- 3.5 N/sq.mm as per ASTM D412,Elongation (L/T) L- 180 % ,T -180 % as per ASTM D 412, Tear Resistance 125 N as per ASTM D 4073, Puncture Resistance- 200 N as per ASTM E 154, Hydrostatic pressure > 60 m (6BAR) No leakage as per DIN 1048, including cleaning the surface, priming the surface with cold applied bituminous primer@4-6 sq.mtr/litre, properly sealing the joints & maintaining 75 mm overlap between the membrane selvedge & 100 mm overlap on the end joints of the membrane over the slab etc. complete.

The system shall be an SBS modified self-adhesive cold applied waterproofing membrane based on a tropical grade of polymer modified bitumen. The bitumen compound is laminated onto an impervious, non-perforated,HDPE film. The membrane is protected on the self-adhesive side with a silicone coated release film.

Termination: Supplying and applying aluminum strip flashing with fasteners at the top and sealing the joints with PU sealant

The laid membrane shall be covered with protection board - spot bonded on retaining wall before backfilling -8mm thick dimple board of compressive strength not less than 200kN/m2. The waterproofing system should be applied directly by the manufacturer with 10 years of complete system guarantee against leakage

The SBS Self-adhesive membrane shall have following technical properties:

Product	Test Standard	Results
Top surface		Cross laminated HDPE valeron
Softening point (oC)	ASTM D36	105
Tensile Strength (L/T) N/sq.mm(compound membrane)	ASTM D 412-06	3.5

Elongation (L/T), (%) (compound membrane)	ASTM D 412 -06	180
Tear Resistance (N) (compound membrane)	ASTM D 4073	125
Puncture Resistance, (N)	ASTM E 15	200
Adhesion to self-lap adhesion N/mm	ASTM D 1000	2.4
Hydrostatic pressure	DIN 1048	> 60 m (6 BAR) No leakage
Crack Bridging Ability, (mm)	ASTM C 836	1.5

METHOD OF APPLICATION :

- The substrate must be free of all dirt, oil grease and loosely adhering particles and made dry. Honeycomb and spalled concrete are to be repaired and all nail heads and protrusions that are likely to puncture the membranes must be removed. All tie rod holes to be packed with shrink material.
- Injection grouting (cementitious grouting) at all construction joints & weaker sections @ 1m C/C through the PVC nipples with 40PSI grout pump using cement slurry mixed with expansive plasticizing admixture @225gms per bag of cement
- Laying of angle fillets (50mm x 50mm) at the junction of slab & vertical walls prepared with cement sand mortar 1:4 admixed with integral waterproofing compound @ 200 ml per 50 kg bag of cement.
- All concrete surfaces will then be primed with a solvent based Bitumen Primer .
- Unroll only the required length of the membrane and cut the pieces to the desired length and shape.
- Place the membrane pieces on the area to be covered and check whether the pieces match with the profile of the marked substrate.
- Re-roll the membrane for about half the length without changing its orientation. Then slowly unroll the membrane, peel off the release film and carefully place the membrane on the surface.
- Smoothen out any entrapped air by pressing from the center to the sides.
- The subsequent rolls are to be laid in such a fashion that there is a 75 mm side overlap on sides and 100mm end overlap.
- The applied membrane is then to be protected from damage by installing 8 mm thick HDPE dimple board spot bonded on retaining wall before backfilling.

PODIUM / LANDSCAPING DECKS (HARDSCAPE & LANDSCAPE)

The system includes base preparation of cleaning, brushing and removal of flacky materials, grouting the porous area with cementitious grout, proper coving between slab and wall junctions and priming the surface with two component solvent free epoxy primer @250g/sqm, followed by sprinkling liberal oven-dried quartz sand over the primer while it is still wet, to provide key for subsequent waterproofing coating.

Providing and applying two component instant setting 100% solids spray applied hybrid polyurea (PU) waterproofing coating having excellent tensile strength of 15MPa and elongation of >400% (as per ASTM D 412), adhesion to concrete of 2MPa (as per ASTM D 4541), puncture

resistance of 1000N (as per ASTM 154) and static crack bridging of up to 2mm (as per ASTM C 836). The coating shall be applied @2.2Kg/sqm to achieve a total DFT of 2 mm and shall be applied on the entire horizontal and shall be terminated at 300mm above the FFL, including reinforcing the coating with 45gsm glass fibre mesh at all corners and change in directions as per the manufacturer's recommendation. Providing & laying 150 gsm geotextile layer over the Pu coating.

Horizontal Protection: Supplying and applying an avr of 75mm thick M20 fibrated grade concrete screed including saw cutting (approx. 6mm W x 30mm D) at 3MX4M panels, making angle fillet of 50mmX50mm using M20 grade concrete at the corners and filling the groove with PU sealant.

Vertical protection: Supplying and applying 15mm thick polymeric waterproof plastering @ 0.2litre/bag of cement with CM 1:4 for the vertical surface.

Landscape areas-Fixing of 10mm thick polypropylene geotextile laminated dimpled board, of compressive strength not less than 400kN/m²

The waterproofing system should be applied directly by the manufacturer with 10 years of complete system guarantee against leakage

Technical properties of two component Hybrid Polyurea Coating

Elongation to break	ASTM D412	400%
Tensile Strength	ASTM D412	15 MPa
Solid Content	ASTM D2369	100 %
Adhesion to concrete	ASTM D4541	2 Mpa
Puncture Resistance	ASTM C154	1000 N
Static Crack Bridging	ASTM D 836	2 mm

METHOD OF APPLICATION

- Clean the surface free from dirt, laitance etc.
- Injection grouting (cementitious grouting) at all construction joints & weaker sections @ 1m C/C through the PVC nipples using cement slurry mixed with expansive plasticizing admixture @225gms per bag of cement.
- Apply Epoxy Primer on cleaned & levelled surface @ 250 grams/sq.mtr. The priming will enhance the adhesion of the membrane to the substrate. Allow the primer to cure according its technical instruction.
- Spray apply two component hybrid polyurea coating on to the primed surface until the full area is covered. The coating shall be applied @2.2Kg/sqm to achieve a total DFT of 2 mm and shall be applied on the entire horizontal and shall be terminated at 300mm above the FFL
- Laying of geotextile membrane over the cured coating to protect it from any damages before protecting the same by concrete screed.
- Horizontal protection: Supplying and laying slope making and protection with 75mm avg. thick of M20 grade fibrated screed including saw cutting (approx. 6mm W x 10mm D) at 3MX4M panels and filling the grove with PU sealant. Curing as per standard practice.
- Vertical protection: Supplying and applying waterproof plastering with CM 1:4 of thickness 20 mm for walls admixed with integral waterproofing compound @ 200ml/bag of cement
- For landscape areas: Fixing of 10mm thick polypropylene geotextile laminated dimpled board, of compressive strength not less than 400kN/m²
- Drain board.

SUNKEN PORTIONS / TOILETS / BALCONIES

Cleaning the internal surface areas thoroughly so that they are free of all contaminants like dirt and laitance & to remove all the loose materials by various mechanical means. Removal of all surface imperfections, protrusions, loose concrete & filling of cracks using SBR latex modified Mortar in the ratio Cement: Sand (1:4) and 5% by weight of cement.

Applying two coats of 2 component polymer modified cementitious coating of tensile strength of 1.0 N/Sq.mm as per ASTM D 412, elongation of 120% as per ASTM D 412, crack bridging of 2mm as per ASTM C836, Shore A hardness of 60 as per ASTM D2240 & resisting 5 bars hydrostatic pressure as per DIN 1048 applied@ 2kg/sq.mtr all over the entire horizontal and extended up to 300mm above the FFL on the vertical surface as per manufacturer's recommendation. Finally sprinkling sand over the third coat for better adhesion with plaster. The interval between each coat of coating application is 6-8 hrs. **Taken above the mother slab for a length of 300 mm vertically coating.**

Horizontal protection: Laying slope making and protection with 40mm avg. thick of M20 grade fibrated screed Curing as per standard procedure

Vertical protection: Applying waterproof plastering with CM 1:4 of thickness 20mm for walls admixed with integral waterproofing compound @ 200ml/bag of cement

Sealing of Pipe cut outs/Bore Packing

Supplying & sealing the Sanitary pipe inserts, provided in the floor & walls with double sided bituminous tape and supplying & grouting the gaps around the pipe inserts with non-shrink free flow grout.

The waterproofing system should be applied directly by the manufacturer with 10 years of complete system guarantee against leakage.

Technical properties of acrylic cementitious coating-

Property	Test Standard	Results
Tensile strength	ASTM D412	1.0 N/Sq.mm
Elongation at break	ASTM D412	120 % minimum
Crack bridging	ASTM D 836	NO cracking up to 2mm
Adhesion strength	ASTM D 4541	0.8 N/sq.mm Minimum
Hardness, Shore A	ASTM D 2240	60
Water penetration (5 bar pressure)	DIN1048	Pass

METHOD OF APPLICATION

1. Clean the surface free of dirt, dust, laitance, etc. and inspect for cracks.
2. Removal of all surface Imperfections, protrusions, loose concrete & filling of cracks using SBR latex Polymer Modified Mortar in the ratio Cement: Sand (1:4) and 5% by weight of cement.
3. Laying of angle fillets (50mm x 50mm) at the junction of slab & vertical walls prepared with cement sand mortar 1:4 admixed with integral waterproofing compound @ 200 ml per 50 kg bag of cement.

4. Supplying & sealing the Sanitary pipe inserts, provided in the floor & walls with double sided bituminous tape and supplying & grouting the gaps around the pipe inserts with non-shrink free flow grout.
5. Whilst damp, but free of standing water, apply Acrylic cementitious coating to the clean and saturated surface maintaining a coverage of 2kg/sq.mtr in two coats.
6. The coating shall be done on the entire horizontal area and shall be continued to vertical areas up to 300mm above FFL, followed by sprinkling of sand on the vertical surface.
7. Horizontal protection: Laying slope making and protection with 40mm avg. thick of M20 grade fibrated screed Curing as per standard procedure.
8. Vertical protection: Applying waterproof plastering with CM 1:4 of thickness 20mm for walls admixed with integral waterproofing compound @ 200ml/bag of cement.

WATER TANKS (OH&UG/STP)

Cleaning the internal surface areas thoroughly so that they are free of all contaminants like dirt and laitance & to remove all the loose materials by various mechanical means. Removal of all surface imperfections, protrusions, loose concrete & filling of cracks using SBR latex modified Mortar in the ratio Cement: Sand (1:4) and 5% by weight of cement.

Providing & grouting at construction joints with cementitious grout into each nozzle (1 mtr c/c) at regular intervals as per the requirements.

Applying 3 coats of 2 component polymer modified cementitious coating of tensile strength of 1.0 N/Sq.mm as per ASTM D 412, elongation of 120% as per ASTM D 412, crack bridging of 2mm as per ASTM C836, Shore A hardness of 60 as per ASTM D2240 & resisting 5 bars hydrostatic pressure as per DIN 1048 applied @ 3kg/sq.mtr all over the slab including the angular fillets and extendable over the vertical walls. Finally sprinkling sand over the third coat for better adhesion with plaster. The interval between each coat of coating application is 6-8 hrs. The waterproofing system should be applied directly by the manufacturer with 10 years of system guarantee against leakages.

Providing and applying 15-20 mm thick CM 1:4 for plastering admixed with integral waterproofing compound admixed @ 0.2litre/bag of cement as per manufacturer's specifications including curing etc.

Additional for potable water tanks-Over the plaster providing & applying two coats of antibacterial antifungal food grade epoxy coating at a consumption of @250/Gms/sq.mtr as per CFTRI 21 CFR 175 - 300 of US - FDA, Water absorption nil as per ASTM C 870:90, adhesion strength of 2.5 N/mm² as per ASTM D4541:02 applied with an interval of 6-8 hrs between each coat over the cured plastered surface as per manufacturer's instruction.

Additional for STP tanks-Over the plaster providing & applying 2 coats of Coal Tar Epoxy at a consumption of @500/Gms/sq.mtr with Bonding / adhesion of 1.2 to 1.4 N/mm² as per ASTM D 4541, Water resistance, immersion - 7 days passes as per ASTM D 870-09, Chemical resistance, immersion in dilute acid alkali & salt solutions - 7 days -Passes as per ASTM 868 as per manufacturer's instruction

Technical properties of acrylic cementitious coating-

Property	Test Standard	Results
Tensile strength	ASTM D412	1.0 N/Sq.mm
Elongation at break	ASTM D412	120 % minimum
Crack bridging	ASTM D 836	NO cracking upto 2mm
Adhesion strength	ASTM D 4541	0.8 N/sq.mm Minimum
Hardness, Shore A	ASTM D 2240	60
Water penetration (5 bar pressure)	DIN1048	Pass

Food grade epoxy coating for potable water tanks

Providing & applying two coats antibacterial antifungal food grade coating with an interval of 6-8 hrs between each coat over the cured plastered surface as per manufacturer’s instruction

The Food grade epoxy coating shall have following typical properties:

Property	Test Standard	Results
Nature		Two components
Mixing ratio, By weight (Base: Hardener: Water)		1:1:1
Adhesion strength	ASTM D 4541	2.5 N/sq.mm
Food grade certification	CFTRI as per 21 CFR 175 - 300 of US - FDA	Passes

STP Tanks-Coal Tar Epoxy Coating

Providing & laying 2 component Coal Tar Epoxy in two coats at a consumption of 3-4 sq.mtr/Kg for 2 coats @ 250-300-micron DFT as complete as per manufacturer's instructions.

Property	Test Standard	Results
Bonding / adhesion, N/MM2	ASTM : D 4541	1.2 - 1.4
Flexibility, Mandrel test	ASTM : D 522 - 93	No cracking of film
Chemical resistance, immersion in dilute acid alkali & salt solutions – 7 days	ASTM : C 868	Passes

METHOD OF APPLICATION

- Ensure a properly clean, sound & leveled substrate, as they should be free from oil, grease, dust & debris. Ensure that the moisture content is less than 10%.
- Make surface smooth, even & free from local depressions with sand –cement mortar modified

- with SBR latex and cure it for minimum 3 days.
- The slurry to be grouted is prepared as per the mixing instructions with non-shrink compound for cementitious grout. Carry out injection grouting either by gravity or with grouting pump using the mixed material. Allow it to cure for at least 24 hrs.
 - Providing and laying gola of 50X50mm thickness all along the angular joints of wall and slab with cement mortar of mix 1:4 admixed with waterproofing compound
 - Clean the surface again thoroughly to make free from dirt, dust laitance etc. and saturate the cleaned concrete surface with ample amount of water.
 - Apply first coat of Acrylic coating on all the surfaces as per instructions & cure it for 6-8 Hrs.
 - Apply the second coat of Acrylic cementitious coating over the properly cured first coat and let the complete treatment air cure for 7 days and so on for the third coat.
 - Provide a protection layer over the waterproofing treatment with a 15-20mm sand cement plaster admixed with integral waterproofing compound as per instructions & cure it for 7 days.
 - Mix the components of food grade coating as per the instructions given & apply two coats on all the plastered surfaces by brush with an interval of 6-8 hrs between each coat.

**Water Proofing Treatment (Pre-Construction) by Chemical Injection System
Horizontal Surface (Raft Slab)**

Before the raft reinforcement is placed in position:

- a) Laying PCC as per drawings and specifications.
- b) Cement slurry (cement and approved water proofing compound) is spread on the PCC for proper bonding with subsequent water proofing treatment.
- c) Water Proofing Course of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) mixed with approved water proofing compound is laid over the slurry. Stone aggregates 12mm down is embedded at random.
- d) After 24 hours, spreading cement slurry (cement and approved water proofing compound) on the 1st layer of mortar.
- e) Providing and laying 2nd layer of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) mixed with approved water proofing compound. Stone aggregate 12mm down size is embedded at random.

After reinforcement of raft is placed in position:

- a) Providing and fixing 25mm dia GI threaded grouting nozzles of adequate length at the specified locations @ 1.50 metres c/c or as shown in the drawing all over the slab. The grouting nozzles are tied with reinforcement in such a manner as not to choke its end during concrete operations. The top of these nozzles protrudes above the raft concrete.
- b) After minimum 7 days of concreting, cement grout of cement and approved water proofing compound (non-shrinkage grouting compound) in proportion as specified is injected, through these nozzles at the pressure of 2.5 to 3.0 Kg/Sq.cm.
- c) After grouting, top of the nozzles is cut and the space is filled with cement mortar 1:2 (1 cement: 2 coarse sand) mixed with approved water proofing compound.

Retaining Wall

- a) The external surface is prepared and approved cement slurry is applied.
- b) Providing and laying 25mm thick cement mortar in 1:4 (1 cement: 4 coarse sand) mixed with approved water proofing compound in two layers with chicken wire mesh 26 or 24-gauge 25mm size in between the two layers.
- c) The G.I. pipes are placed at 1.5m c/c in both directions, and, 0.75 m C/C along construction joints and securely fastened to the reinforcement prior to shuttering and

concreting or alternately by drilling holes (25mm to 32mm dia) in the concrete upto a depth as shown in the drawing all over the wall surface @ 1.50mt. C/C and as shown in the drawing. Treatment along all construction joints by providing nozzles, as above, shall also be executed.

- d) Fixing 25mm dia G.I. threaded nozzles in these holes with cement mortar 1:4 (1 cement: 4 coarse sand) mixed with water proofing compound.
- e) Injecting cement grout of cement and polymer-based water proofing compound (non-shrinkage grouting compound) in proportion as specified in these nozzles at a pressure of 2.5 to 3.0 Kg/Sq.cm.
- f) After the grout the nozzles are cut and filled with cement mortar 1:2 mixed with polymer-based water proofing compound in proportion as specified and finished smooth.

Note: The proportion of approved water proofing compound to be used in respect of ordinary cement shall be as per manufacturer's specifications.

Guarantee for water proofing:

Work to be get executed through an approved specialized agency & covered by 10 years guarantee by the main contractor against leakage, seepage and dampness etc. for which necessary performance guarantee for requisite indicated value of work shall be furnished by the contractor before completion.

Integral Cement Based Water Proofing Treatment for Roof /Sunken Floors of W.C`S etc.

- a. The proprietary water proofing compound shall conform to I.S.2645 – 1975 in cement-based water proofing treatment, stone aggregate shall be used instead of brick aggregate without any extra cost wherever required by the Engineer in – charge.
- b. The finished surface after water proofing treatment shall have required slope.
- c. While treatment of sunken floors is done it shall be ensured that the 'S' or 'P' traps as the case may be have been fixed / eased and rounded off properly the work shall be carried out as per relevant CPWD specifications.
- d. GURANTEE: The above water proofing, treatment shall be guaranteed for TEN YEARS against any leakage etc. the contractor shall have to execute a bond, 10 % of cost of items executed for water proofing shall be retained for 10 years as security (Refer GCC provisions).

Water Proofing Treatment Integral Crystalline Waterproofing Materials Integral Crystalline Waterproofing Admixture

i. Materials

Integral Crystalline Admix is one-part cementitious powder consisting of hydrophilic chemicals such as Portland cement, very fine treated silica sand and various active, proprietary chemicals. These active chemicals react with the moisture in fresh concrete with the by-products of cement hydration to cause a catalytic reaction, which generates a non-soluble crystalline formation throughout the pores and capillary tracts of the concrete. Thus, the concrete becomes permanently sealed against the penetration of water or liquids from any direction. The concrete is also protected from deterioration due to harsh environmental conditions.

ii. Technical Specification/Parameters

The integral crystalline waterproofing admixture shall confirm to the following requirements:

- a. At the manufacturers recommended dosage,

- i. Material must fulfil the requirements of American concrete institute guidelines **ACI-212-3R-10**, the coefficient of permeability should be measured for penetration of water. Under hydrostatic pressure of 72.5 psi (5 bars) to 150 psi (10 bars) for 72 to 96 hours as per DIN 1048 Part V. Reduction of water penetration should be 50 to 90%.
- ii. The performance of the crystalline admixture must not be restricted by water/cement ratio of the concrete mix. In other words, the crystalline admixture must perform at any water / cement ratio of the concrete mix.
- b. The product has **no** corrosion effect on reinforcement steel according to test norm DIN V 18998. The maximum chloride content lies less than 0.1% and maximum alkali content less than 9.3%.
- c. The integral crystalline admixture must be compatible with any other concrete admixture confirming to ASTM D494 and IS 9103.
- d. It will not be affected by wear abrasion of the treated concrete surface and crystalline treated concrete shall not require protection layer.
- e. The recommended crystalline admixture shall be non-toxic and shall confirm to NSF 61 USA.

Note - The manufacturer shall produce relevant test certificates as per relevant code as stated above.

- iii. **Recommended Uses:** - In locations such as Foundations / Rafts, Sewage and Water Treatment Plants, Parking Structures Underground Retaining Walls etc.

iv. Direction for use

- a. **Dosage** - **0.80%** by weight of cement content per cubic meter of reinforced concrete.

v. Preparation of mixing

Mix integral crystalline admixture with water to form a very thin slurry (e.g. 40 lbs (18 kg) of powder mixed with 6 gallons (22.7 ltr) of water). Pour the required amount of material into the drum of the ready-mix truck and mix for at least 5 minutes to ensure even distribution of integral crystalline admixture throughout the concrete.

vi. Application

Concrete treated with integral crystalline admixture should be placed and finished in accordance with good concrete practices. ACI guidelines and recommendations should be observed.

vii. Precaution / Special Consideration

It is important to obtain a homogeneous mixture of crystalline admixture with the concrete. Therefore, do not add dry crystalline admixture powder directly to wet concrete as this may cause clumping and through dispersion will not occur.

When incorporating integral crystalline admixture, the temperature of the concrete mix should be above 40°F (4°C).

viii. Storage / Shelf life

Integral crystalline admixture must be stored dry at a minimum temperature of 45°F (7°C) and its shelf life is one year when stored under proper conditions.

Integral Crystalline Slurry

i. Materials

Integral crystalline slurry is a surface-applied, integral crystalline waterproofing material, which waterproofs and protects concrete in-depth. It consists of Portland cement, specially treated quartz sand and a compound of active chemicals. Integral crystalline slurry needs only to be mixed with water prior to application. When Integral crystalline slurry is applied to a concrete surface, the active chemicals react with moisture and the by-products of cement hydration to cause a catalytic reaction which generates an insoluble, crystalline structure. These crystals fill the pores and minor shrinkage cracks in the concrete to prevent any further water ingress (even under pressure). However, Integral crystalline slurry will still allow the passage of vapour through the structure (i.e. the concrete will be able to "breathe"). Even after the concrete has cured, Integral crystalline slurry remains dormant in the concrete and will reactivate in the presence of moisture to seal capillary tracts and hairline cracks. In addition to waterproofing the structure, Integral crystalline slurry protects concrete against seawater, wastewater, aggressive ground water and many other aggressive chemical solutions. Integral crystalline slurry is approved for use in contact with potable water, and is therefore suitable for use in water storage tanks, reservoirs, water treatment plants, etc. Integral crystalline slurry is not a decorative material.

ii. Technical Specification/Parameters

- a. Material must fulfil the requirements of American concrete institute guidelines **ACI-212-3R-10**, the coefficient of permeability should be measured for penetration of water. Under hydrostatic pressure of 72.5 psi (5 bars) to 150 psi (10 bars) for 72 to 96 hours as per DIN 1048 Part V. Reduction of water penetration should be 50 to 90%.
- b. Potable Water Compatibility: Nontoxic and suitable for use in potable water facilities – NSF Listed as per ANSI 61 listing.
- c. Confirm to EN 1504-3 (For structural repairs – R3, Compressive strength > 25 Mpa), supplied from an approved manufacturing unit having CE approval conforming to EN 1504-3-R3.
- d. The product has no corrosion effect on reinforcement steel according to test norm DIN V 18998. The maximum chloride content lies less than 0.1% and maximum alkali content less than 9.3%.

Note - The manufacturer shall produce relevant test certificates as per relevant code as stated above.

- iii. **Recommended Uses:** - In locations such as Foundations / Rafts, Sewage and Water Treatment Plants, Parking Structures Underground Retaining Walls etc.

iv. Surface Preparation

All concrete to be treated with Integral crystalline slurry must be clean and have an "open" capillary surface. Remove laitance, dirt, grease, etc. by means of high-pressure water jetting, wet sandblasting or wire brushing. Faulty concrete in the form of cracks, honeycombing, etc. must be chased out, treated with Integral crystalline slurry and filled flush with crystalline mortar. Surfaces must be carefully prewatered prior to the Integral crystalline slurry application. The concrete surface must be damp but with no wet sheen on the surface.

v. Preparation of Material

Integral crystalline slurry is mechanically mixed with clean water to a creamy consistency or that resembling thick oil. Mix only as much material as can be used within 20 minutes and stir mixture frequently. If the mixture starts to set do not add more water, simply re-stir to restore workability.

vi. Mixing ratios

Application	Vertical Surfaces	Horizontal Surfaces
Brush Application	5 parts integral crystalline slurry to 2 parts water	3 parts integral crystalline slurry to 1-part water
Spray Application	5 parts integral crystalline slurry to 2.75-3.25 parts water	

vii. Application

Crystalline slurry is prepared by mixing 1.00 kg of crystalline slurry with 400 ml of water and applying the same from internal side with the help of synthetic fiber brush @0.70kg per sqm per coat in two coats after cleaning the entire concrete surface thoroughly with high pressure water jet / wire brush or by mechanical means to make it free from loose particles, dust and dirt etc. and making the surface saturated with water before application of crystalline slurry. Second coat shall be applied within 4-6 hours of first coat.

Apply integral crystalline slurry in two coats by masonry brush or appropriate power spray equipment.

The second coat is applied while the first coat is still "green".

viii. Application Rates

For vertical surface - Two slurry coats of Integral crystalline slurry at 0.70 kg per sqm per coat for horizontal surface – One slurry coat of Integral crystalline slurry at 1.10 kg per sqm.

ix. Post Treatment

The treated areas shall be kept damp for a period of five days and be protected against direct sun, wind and frost, by covering with polyethylene sheeting, damp burlap or similar.

x. Precaution / Special Consideration

Do not apply Integral crystalline slurry at temperatures at or below freezing or to frozen or freezing surfaces. Integral crystalline slurry cannot be used as an additive to concrete or plasters. (Integral crystalline admixture should be considered for these applications).

xi. Storage / Shelf Life

When properly stored in a dry place in unopened and undamaged original packaging its shelf life is 12 months.

Integral Crystalline Dry-Shake

i. Materials

Integral crystalline dry shake of hydrophilic in nature is a unique chemical treatment material for the waterproofing and protection of concrete. Integral crystalline dry shake has been specially formulated for dry-shake applications on horizontal concrete surfaces where greater impact and abrasion resistance is required. Packaged in the form of a dry powder compound, Integral crystalline dry shake consists of Portland cement, various active proprietary chemicals, and a synthetic aggregate hardener that has been crushed and graded to particle sizes suitable for concrete floors. Integral crystalline dry shake becomes an integral part of the concrete surface, thereby eliminating problems normally associated with coatings (e.g. scaling, dusting, flaking and delamination). The active chemicals react with the moisture in the fresh concrete causing a catalytic reaction, which generates a non-soluble crystalline formation within the pores and capillary tracts of the concrete.

ii. Technical Specification/Parameters

- a. Material must fulfil the requirements of American concrete institute guidelines ACI-212-3R-10, the coefficient of permeability should be measured for penetration of water. Under hydrostatic pressure of 72.5 psi (5 bars) to 150 psi (10 bars) for 72 to 96 hours as per DIN 1048 Part V. Reduction of water penetration should be 50 to 90%.
- b. Potable Water Compatibility: Nontoxic and suitable for use in potable water facilities – NSF Listed as per ANSI 61 listing.
- c. Confirm to EN 1504-3 (For structural repairs – R3, Compressive strength > 25 Mpa), supplied from an approved manufacturing unit having CE approval conforming to EN 1504-3-R3.
- d. The product has no corrosion effect on reinforcement steel according to test norm DIN V 18998. The maximum chloride content lies less than 0.1% and maximum alkali content less than 9.3%.

iii. Recommended Uses: -

Raft / Foundation Slabs, Below-grade Structures Sewage and Water Treatment Plants Traffic Bearing Surfaces Warehouse Floors Parking Structures etc.

iv. Directions for Application

a. Application Rates

Under normal conditions, the coverage rate for Integral crystalline dry shake is 0.60 kg per sqm depending on the degree of abrasion resistance required.

b. Application Procedure

Integral crystalline dry shake is to be sprinkled @ 0.60 kg per sqm over the PCC blinding, after fixing the reinforcement bars on the cured PCC so as to achieve positive side waterproofing below the raft concrete, as per the manufacture's specification.

c. Curing

Curing is important and shall begin as soon as final set has occurred but before surface starts to dry. Conventional moist curing procedures such as water spray, wet burlap or plastic covers may be used. Curing shall continue for at least 48 hours.

v. Precaution / Special Consideration

For the best results when applying dry shake materials, the air content of the concrete shall not exceed 3% (a high air content can make it difficult to achieve a proper application).

In hot, dry, or windy conditions, it is advisable to use an evaporation retardant on the fresh concrete surface to prevent premature drying of the slab.

Chronic moving cracks or joints will require a suitable flexible sealant.

vi. Storage / Shelf Life

Integral crystalline dry shake must be stored dry at a minimum temperature of 45°F (7°C) and its shelf life is one year when stored under proper conditions.

5.1 STRUCTURAL STEEL WORK

5.1.1 This specification covers the fabrication and transportation to site and erection on prepared foundations and structural steel work consisting of beams, columns, vertical trusses, bracings, shear connections etc.

5.1.2 Fabrication, erection and approval of steel structures shall be in compliance with :

- These General Specifications and IS : 800 - 1984
- Drawings and supplementary drawings to be supplied to the contractors during execution of the work.

5.1.3 Providing shop primer coat for steel structures. Grouting of holding-down bolt pockets and below base plates where required.

5.1.4 In case of conflict between the Clauses mentioned here and the Indian Standards, those expressed in this specification shall govern.

5.2 Scope

5.2.1 The fabrication and erection of the steel work consists of accomplishing of all jobs here-in enumerated including providing all labour, tools and plant all materials and consumables such as welding electrodes, bolts and nuts, oxygen and acetylene gases, oils for cleaning etc. of approved quality as per relevant IS. The work shall be executed according to the drawings, specifications, relevant codes etc. in an expeditious and workman like manner, as detailed in the specifications and the relevant Indian Standard Codes and Standard Practice and to the complete satisfaction of the Engineer-in-charge.

5.3 Fabrication Drawings

5.3.1 The contractor shall prepare all fabrication and erection drawings on the basis of design drawings supplied to him and submit the same in triplicate to the Engineer-in-charge for review, Engineer-in-charge shall review and comment, if any, on the same. Such review, if any, by the Engineer-in-charge, does not relieve the contractor of any of his required guarantees responsibilities. The contractor shall however be responsible to fabricate the structural strictly conforming to specifications and reviewed drawings.

5.3.2 Fabrication drawings shall include the following :

- Member sizes and details
- Types and dimensions of welds and bolts
- Shapes and sizes of edge preparation for welding
- Details of shop and field joints included in assemblies.

Bill of material

- Quality of structural steels, welding electrodes, bolts, nuts and washers etc. to be used.
- Erection assemblies, identifying all transportable parts and sub-assemblies, associated with special erection instructions, if required.
- Calculations where asked for, for approval.

5.3.3 Connections, splices etc. other details not specifically detailed in design drawings shall be suitably given on fabrication drawings considering normal detailing practices and developing full member strengths. Where asked for calculations for the merit shall also be submitted for approval.

5.3.4 Any alternate design or change in section is allowed when approved in writing by the Engineer-in-charge.

5.3.5 However if any variation in the scheme is found necessary later, the contractor will be supplied with revised drawings. The contractor shall incorporate these changes in his drawings at no extra cost and resubmit for review.

5.3.6 Engineer-in-charge review shall not absolve the contractor of his responsibility for the correctness of dimensions, adequacy of details and connections. One copy will be returned reviewed with or without comments to the contractor for necessary action. In the former case further three copies of amended drawings shall be submitted by the contractor for final review.

5.3.7 The contractor shall supply three prints each of the final reviewed drawings to the Engineer-in-charge within a week since final review, at no extra cost for reference and records.

5.3.8 The Engineer-in-charge will verify the correct interpretation of their requirements.

5.3.9 If any modification is made in the design drawing during the course of execution of the job, revised design drawings will be issued to the contractor. Further changes arising out of these shall be incorporated by the contractor in the fabrication drawings already prepared at no extra cost and the revised fabrication drawings shall be duly got reviewed as per the above Clauses.

5.4 Materials

5.4.1 Rolled Sections

The following grades of steel shall be used for steel structures :

Structural steel will generally be of standard quality conforming to IS: 226. Whenever welded construction is specified plates of more than 20 mm thickness will generally conform to IS: 2062.

5.4.2 Welding Materials

Welding electrodes shall conform to IS: 814.

Approval of welding procedures shall be as per IS: 823.

5.4.3 Bolts, Nuts & Washers

Bolts and nuts shall be as per IS: 1367 and tested as per IS:1608. It shall have a minimum tensile strength of 44 Kg/mm² and minimum elongation of 23% on a gauge length of 5.65 (A- Original cross-sectional area of the gauge length). Washers shall be as per IS: 2016.

5.4.4 All materials shall conform to their respective specifications. The use of equivalent or higher grade or alternate materials will be considered only in very special cases subject to the approval of the Engineer-in-charge in writing.

5.4.5 Receipt & Storing of Materials

Steel materials supplied by the contractor must be marked for identification and each lot should be accompanied by manufacturer's quality certificate, conforming chemical analysis and mechanical characteristics.

All steel parts furnished by supplier shall be checked, sorted out, straightened, and arranged by grades and qualities in stores.

Structurals with surface defects such as pitting, cracks, laminations etc. shall be rejected if the defects exceed the allowable tolerances specified in relevant standards or as directed by the Engineer-in-charge.

Welding wire and electrodes shall be stored separately by qualities and lots inside a dry and enclosed room, in compliance with IS: 816 - 1969 and as per instructions given by the Engineer-in-charge. Electrodes shall be perfectly dry and drawn from an electrode even, if required.

Checking of quality bolts of any kind as well as storage of same shall be made conforming to relevant standards.

Each lot of electrodes, bolts, nuts, etc. shall be accompanied by manufacturer's test certificate.

The contractor may use alternative materials as compared to design specification only with the written approval of the Engineer-in-charge.

5.4.6 Material Tests

The contractor shall be required to produce manufacturer's quality certificates for the materials supplied by the contractor. Notwithstanding the manufacturer's certificates, the Engineer-in-charge may ask for testing of materials in approved test houses. The test results shall satisfy the requirements of the relevant Indian Standards.

Whenever quality certificates are missing or incomplete or when material quality differs from standard specifications the contractor shall conduct all appropriate tests as directed by the Engineer-in-charge at no extra cost.

Materials for which test certificates are not available or for which test results do not tally with relevant standard specifications, shall not be used.

5.5 Fabrication

Fabrication shall be in accordance with IS: 800 Section V in addition to the following :

Fabrication shall be done as per approved fabrication drawings adhering strictly to work points and work lines on the same. The connections shall be welded or bolted as per design drawings. Work shall also include fabricating built up sections.

Any defective material used shall be replaced by the contractor at his own expense, care being taken to prevent any damage to the structure during removal.

All the fabricated and delivered items shall be suitably packed to be protected from any damage during transportation and handling. Any damage caused at any time shall be made good by the Contractor at his own cost.

Any faulty fabrication pointed out at any stage of work shall be made good by the contractor at his own cost.

5.5.1 Preparation of Materials

Prior to release for fabrication, all rolled sections warped beyond allowable limit shall be pressed or rolled straight and freed from twists, taking care that a uniform pressure is applied.

Minor warping, corrugations etc. in rolled sections shall be rectified by cold working. The sections shall be straightened by hot working where the Engineer-in-charge so direct and shall cooled slowly after straightening.

Warped members like plates and flats may be used as such only if wave like deformation does not exceed $L/1000$ but limited to 10 mm (L-Length).

Surface of members that are to be jointed by lap or fillet welding or bolting shall be even so that there is no gap between overlapping surfaces.

5.5.2 Marking

Marking of members shall be made on horizontal pads, of an appropriate racks or supports in order to ensure horizontal and straight placement of such members.

Marking accuracy shall be at least + 1 mm.

5.5.3 Cutting

Members shall be cut mechanically (by saw or shear or by oxyacetylene flame).

All sharp, rough, or broken edges, and all edges of joints which are subjected to tensile or oscillating stresses, shall be ground.

No electric metal arc cutting shall be allowed.

All edges cut by oxyacetylene process shall be cleaned of impurities prior to assembly.

Cutting tolerances shall be as follows :

- a) For members connected at both ends + 1 mm.
- b) Elsewhere + 3 mm.

The edge preparation for welding of members more than 12 mm thick shall be done by flame cutting and grinding. Cut faces shall not have cracks or be rough.

Edge preparation shall be as per IS : 823 - 1964.

5.5.4 Drilling

Bolts holes shall be drilled.

Drilling shall be made to the diameter specified in drawings.

No enlarging of holes filling, by mandrolling or oxyacetylene flame shall be allowed.

Allowed variations for holes (out-of-roundness, eccentricity, plumb-line deviation) shall be as per IS:800.

- Maximum deviation for spacing of two holes on the same axis shall be + 1 mm.
- Two perpendicular diameters of any oval hole shall not differ by more than 1 mm.

Drilling faults in holes may be rectified by reaming the holes to the next upper diameter, provided that spacing of new hole centres and distance of hole centres to the edges of members are not less than allowed and that the increase of hole diameter does not impair the structural strength. Hole reaming shall be allowed if the number of faulty holes does not exceed 15% of the total number of holes for one joint.

5.5.6 Preparation of Members for Welding

Assembly of structural members shall be made with proper jigs and fixtures to ensure correct positioning of members (angles, axes nodes etc.)

Sharp edges, rust of cut edges, notches, irregularities and fissures due to faulty cutting shall be chipped or ground or filled over the length of the affected area, deep enough to remove faults completely.

Edge preparation for welding shall be carefully and accurately made so as to facilitate a good joint.

Generally, no special edge preparation shall be required for members under 8 mm thick.

Edge preparation (beveling) denotes cutting of the same so as to result in V, X K or U seam shapes as per IS: 823.

The members to be assembled shall be clean and dry on the welding edges. Under no circumstances shall wet, greasy, rust or dirt covered parts be assembled. Joints shall be kept free from any foreign matter likely to get in to the gaps between members to be welded.

Before assembly the edges to be welded as well as adjacent areas extending for at least 20 mm shall be cleaned (until metallic polish is achieved).

When assembling members, proper care shall be taken of welding shrinkage and distortions, as the drawing dimensions cover finished dimensions of the structure.

The elements shall be got checked and approved by the Engineer-in-charge or their authorised representative before assembly.

The permissible tolerances for assembly of members preparatory to welding shall be as per IS: 823-1964.

After the assemble has been checked, temporary tack welding in position shall be done by electric welding, keeping in view finished dimensions of the structure.

5.5.7 Welding procedures

Welding shall be carried out only by fully trained and experienced welders as tested and approved by the Engineer-in-charge. Any test carried out either by the Engineer-in-charge of their representative or the inspectors shall constitute a right by them for such tests and the cost involved thereon shall be borne by the contractor himself.

Qualification tests for welders as well as tests for approval of electrodes will be carried out as per IS: 823. The nature of test for performance qualification of welders shall be commensurate with the quality of welding required on this job as judged by the Engineer-in-charge.

The steel structures shall be automatically, semi-automatically or manually welded.

Welding shall begin only after the checks mentioned in Clause 5.1 to 5.6 have been carried out.

The welder shall mark with his identification mark on each element welded by him. When welding is carried out in open air, steps shall be taken to protect the face of welding against wind or rain. The electrodes, wire and parts being welded shall be dry.

Before beginning the welding operation, each joint shall be checked to ensure that the parts to be welded are clean and root gaps provided as per IS: 823.

For continuing the welding of seems discontinued due to some reason, the end of the discontinued seem shall be melted in order to obtain a good continuity. Before resuming the welding operation, the groove as well as the adjacent parts shall be well cleaned for a length of approx. 50 mm.

For single butt welds (in V, 1/2 V or U) and double butt welds (in K, double U etc.) the rewelding of the root is mandatory but only the metal deposit on the root has been cleaned by back gouging or chipping.

The welding seams shall be left to cool slowly. The contractor shall not be allowed to cool the welds quickly by any other method.

For multi-layer welding, before welding the following layer, the formerly welded layer shall be cleaned metal bright by light chipping and wire brushing. Backing strips shall not be allowed.

The order and method of welding shall be so that -

- No unacceptable deformation appears in the welded parts.
- Due margin is provided to compensate for contraction due to welding in order to avoid any high permanent stresses.

The defects in welds must be rectified according to IS: 823 and as per instruction of Engineer-in-charge.

5.5.8 Weld Inspection

The weld seams shall satisfy the following :

- shall correspond to design shapes and dimensions.
- shall not have any defects such as cracks, incomplete penetration and fusion, undercuts, rough surfaces, burns, blow holes and porosity etc. beyond permissible limits.

During the welding operation and approval of finished elements, inspections and tests shall be made as shown in annexure-B.

The mechanical characteristics of the welded joints shall be as in IS: 823.

5.5.9 Preparation of Members for Bolting

The members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending.

Before assembly, all sharp edges, shavings, rust dirt, etc. shall be removed.

Before assembly, the contacting surfaces of the members shall be cleaned and given a coat of primer as per IS: 2074.

The members which are bolt assembled shall be set according to drawings and temporarily fastened with erection bolts (minimum 4 pieces) to check the coaxiality of the holes.

The members shall be finally bolted after the deviations have been corrected, after which there shall not be gaps.

Before assembly, the members shall be checked and got approved by the Engineer-in-charge.

The difference in thickness of the sections that are butt assembled shall not be more than 3% or maximum 0.8 mm whichever is less. If the difference is larger, it shall be corrected by grinding or filling.

Reaming of holes to final diameter or cleaning of these shall be done only after the parts have been check assembled.

As each hole is finished to final dimensions (reamed if necessary) it shall be set and bolted up. Erection bolts shall not be removed before other bolts are set.

5.5.10 Bolting up

Final bolting of the members shall be done after the defects have been rectified and approval of joints obtained.

The bolts shall be tightened starting from the centre of joint towards the edge.

5.5.11 Planing of Ends

Planning of ends of members like column ends shall be done by grinding when so specified in the design.

Planing of butt-welded members shall be done after these have been assembled, the spare edges shall be removed with grinding machines or files.

The following tolerances shall be permitted on member that have been planed.

- On the length of the member having both ends planed, maximum + 2 mm with respect to design.
- Level differences of planed surfaces, maximum 0.3 mm.
- Deviation between planed surface and member's axis maximum 1/1500.

5.5.12 Holes for Field Joints

Holes for field joints shall be drilled in the shop to final diameters and tested in the shop, with trial assemblies.

When three-dimensional assembly is not possible in the shop, the holes for field joints may be drilled in shop and reamed on site after erection, on approval by the Engineer-in-charge.

For bolted steel structures, trial assembly in shop is mandatory.

The tolerance for spacing of holes shall be + 1 mm.

5.5.13 Tolerances

All tolerances regarding dimensions, geometrical shapes and sections of steel structures, shall be as per Annexure B, if not specified in the drawing.

5.5.14 Marking for Identification

All elements and members prior to despatch for erection shall be shop marked.

The members shall be visibly marked with a weather-proof light-coloured paint. The size and thickness of the numbers shall be chosen as to facilitate the identification of members.

For the small members that are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle, while the crates shall be marked directly.

Each bundle or crate shall be packed with members for one and the same assembly; in the same bundle or crate, general utility members such as bolts, quests etc. may be packed.

All bill of materials showing weight, quality and dimension of contents shall be placed in the crates.

The members shall be marked with a durable paint, in a visible location, preferably at one end of the member so that these may be easily checked during storage and erection.

All members shall be marked in the shop before inspection and acceptance.

When the member is being painted, the marking area shall not be painted but bordered with white paint.

The marking and job symbol shall be registered in all shop delivery documents (transportation, for erection etc.)

5.5.15 Shop Test Pre-assembly

For steel structures that have the same type of welding the shop test pre-assembly shall be performed on one out of every 10 members minimum.

For bolted steel structures, shop test pre-assembly is mandatory for all elements as well as for the entire structure in conformity with Clause 5.12.

5.6 Shop Inspection and Approval

5.6.1 General

The Engineer-in-charge or their representative shall have free access at all responsible times to the contractor's fabrication shop and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with drawings and specifications.

Technical approval of the steel structure in the shop by the Engineer-in-charge is mandatory.

The contractor shall not limit the number and kinds of tests, final as well as intermediate once, or extra tests required by the Engineer-in-charge.

The contractor shall furnish necessary tools, gauges, instruments etc. and technical non-technical personnel for shop tests by the Engineer-in-charge, free of cost.

5.6.2 Shop Acceptance

The Engineer-in-charge shall inspect and approve at the following stages :

The following approvals may given in shop :

- Intermediate approvals of work that cannot be inspected later.
- Partial approvals
- Final approvals

Intermediate approval of work shall be given when a part of the work is preformed later :

- Cannot be inspected later
- Inspection would be difficult to perform and results would not be satisfactory.

Partial approval in the shop is given on members and assemblies of steel structures before the primer coat is applied and includes :

- Approval of materials
- Approval of field joints
- Approval of parts with planed surfaces
- Test erection
- Approval of members
- Approval of markings
- Inspections and approvals of special features, like Rollers, loading platform mechanism etc.

During the partial approval, intermediate approvals as well as all former approvals, shall be taken in to consideration.

5.6.3 Final approval in the Shop

The final approval refers to all elements and assemblies of the steel structures, with shop primer coat, ready for delivery from shop to be loaded for transportation, or stored.

The final approval comprises of :

- Partial approvals
- Approval of shop primer coat
- Approval of mode of loading and transport
- Approval of storage (for materials stored)

5.7 Painting and Delivery

5.7.1 Preparation of parts for shop painting

Painting shall consist of providing one coat of red oxide zinc chromate primer to steel members before despatch from shop.

Primer coat shall not be applied unless :

- Surface have been wire brushed, cleaned of dust, oil, rust etc.

- Erection gaps between members, spots that cannot be painted or where moisture or other aggressive agents may penetrate, have been filled with an approved type of oil and putty.
- The surface to be painted are completely dry.
- The parts where water or aggressive agents may collect (during transportation, storage, erection and operation) are filled with putty and provided with holes for drainage of water.
- Members and parts have been inspected and accepted
- Welds have been accepted.

The following are not to be painted or protected by any other product :

- Surface which are in the vicinity of joints to be welded at site.
- Surfaces bearing markings
- Other surfaces indicated in the design.

The following shall be given a coat of hot oil or any approved resistant lubricant only.

- Planed surfaces
- Holes for links

The surfaces that are to be embedded or in contact with the concrete shall be given a coat of cement wash.

The surfaces which are in contact with the ground, gravel or brick work and subject to moisture, shall be given bituminous coat.

The other surfaces shall be given a primer coating.

Special attention shall be given to locations not easily accessible, where water can collect and which after assembly and erection cannot be inspected, painted and maintained. Holes shall be provided for water drainage and in accessible box type sections shall be hermetically sealed by welds.

If specified elsewhere, in the schedule of quantities, the contractor shall paint further coats of red-oxide after erection and placing in position of the steel structures.

5.7.2 Packing, transportation, delivery

After final shop acceptance and marking, the item shall be packed and loaded for transportation.

Packing must be adequate to protect item against warping during loading and unloading.

Proper lifting devices shall be used for loading, in order to protect items against warping.

Slender projecting parts shall be braced with additional steel bars, before loading, for protection against warping during transportation.

Loading and transportation shall be done in compliance with transportation rules.

If certain parts cannot be transported in the lengths stipulated in the design, the position and type of additional splice joints shall be approved by the Engineer-in-charge.

Items must be carefully loaded on platforms of transportation means to prevent warping, bending or falling during transportation.

The small parts such as fish-plates, quests etc. shall be securely tied with wire to their respective parts.

Bolts, nuts and washers shall be packed and transported in crates.

The parts shall be delivered in the order stipulated by the Engineer-in-charge and shall be accompanied by document showing:

- Quality and quantity of structure or members
- Position of member in the structure
- Particulars of structure
- Identification number job symbol.

5.8 **Field Erection**

5.8.1 The erection work shall be permitted only after the foundation or other structure over which the steel work will be erected is approved and is ready for erection.

5.8.2 The contractor shall satisfy himself about the levels, alignment etc. for the foundations well in advance, before starting the erection. Minor chipping etc. shall be carried out by the contractor on his expense.

5.8.3 Any faulty erection done by the contractor shall be made good at his own cost.

5.8.4 Approval by the Engineer-in-charge or their representatives at any stage of work does not relieve the contractor of any of his required guarantees of the contract.

5.8.5 Storage and preparation of parts prior to erection

The storage place for steel parts shall be prepared in advance and got approved by the Engineer-in-charge before the steel structures start arriving from the shop.

A platform shall be provided by the Contractor near the erection site for preliminary erection work.

The contractor shall make the following verifications upon receipt of material at site.

- for quality certificates regarding materials and workmanship according to these general specifications and drawings.
- Whether parts received are complete without defects due to transportation, loading and unloading and defects, if any, are well within the admissible limit.

For the above work sufficient space must be allotted in the storage area.

Steps shall be taken to prevent warping of items during unloading.

The parts shall be unloaded, stored and stored so as to be easily identified.

The parts shall be stored according to construction symbol and markings so that these may be taken out in order or erection.

The parts shall be at least 150 mm clear from ground on wooden or steel blocks for protection against direct contact with ground and to permit drainage of water.

If rectification of members like straightening etc. are required, these shall be done in a special place allotted which shall be adequately equipped.

The parts shall be clean when delivered for erection.

5.8.6 **Erection & Tolerances**

Erection in general shall be carried out as required and approved by the Engineer-in-charge.

Positioning and levelling of the structure, alignment and plumbing of the stanchion and fixing every member of the structure shall be in accordance with the relevant drawings and to the complete satisfaction of the Engineer-in-charge.

The following checks and inspection shall be carried out before during and after erection.

- damage during transportation
- accuracy of alignment of structures
- erection according to drawings and specifications
- progress and workmanship.

In case there be any deviations regarding positions of foundations or anchor bolts, which would lead to erection deviations, the Engineer-in-charge shall be informed immediately. Minor rectifications in foundations, orientation of bolts holes etc. shall be carried out as part of the work, at no extra cost.

The various parts of the steel structure shall be so erected so to ensure stability against inherent weight, wind and erection stresses.

The structure shall be anchored and final erection joints completed after plan and elevation positions of the structural members have been verified with corresponding drawings and approved by the Engineer-in-charge.

The bolted joints shall be tightened so that the entire surface of the bolt heads and nuts shall rest on the member. For parts with sloping surfaces tapered washers shall be used.

5.9 Final acceptance and handing over the structure

5.9.1 At acceptance, the contractor shall submit the following documents :

- Shop and erection drawings - either in tracings or reproducible.
- 4 copies of each of the following :
 - \- shop acceptance documents

- \- quality certificate for structurals, plates, etc. (electrodes, welding wire, bolts, nuts, washers etc.)
- \- List of certified welders who worked on erection of structures.
- \- acceptance and intermediate control procedure of erection operations.

5.9.2 Approval by the Engineer-in-charge at any stage of work does not relieve the contractor of any of his required guarantees of the contract.

5.10 **Grouting of Pockets**

5.10.1 Grouting of pockets and under base plates will be done only after the steel work has been levelled and plumbed and the bases of stanchions are supported by steel shims. The space below the base plate and pockets shall be thoroughly cleaned.

5.10.2 The mortar used for grouting shall not be leaner than 1:2 (1 cement : 2 sand) (grade 300 in case of concrete) and shall be mixed to the minimum consistency required. It shall be poured under suitable head and tamped until the space has been completely filled.

5.11 Tolerances allowed in the erection of plant building without cranes

The maximum tolerances for line and level of the steel work shall be + 3.00 mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10 M. section of height and not more than 7.0 mm per 30 M. section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

**SECTION - 6
PILING**

6.0 GENERAL REQUIREMENT

6.1 Content

This section covers the technical requirement for installation of bored cast-in-situ reinforced concrete vertical piles of specified load carrying capacity and diameter, including load tests on piles for all types of structures.

6.1.1 In case of bored piles, the initial test piles as well as the working piles shall be installed using the rotary hydraulic rig using air lift technique with bentonite slurry.

6.1.2 The Contractor shall ensure and guarantee the "safe load" carrying capacities both for initial test piles and working piles, as mentioned in the Annexure-I.

6.2. Codes and Standards

Some of the relevant Indian Standards, codes etc. applicable to this section of specification are enlisted below:

IS : 1892 Code of practice for subsurface investigation for foundation

IS : 2131 Method of standard penetration test for soils

IS : 2911 Code of practice for design and construction of pile foundations

(Part 1/Sec.1) Driven cast in situ concrete piles.

(Part 1/Sec 2) Bored cast-in-situ concrete piles.

(Part-IV) Load test on piles.

IS : 6926 Code of practice for diamond core drilling for site investigation for river valley projects.

6.3 PILE INSTALLATION

6.3.1 Installation of piles shall be carried out as per pile layout drawings, installation criteria and the instructions of the Engineer. Piles shall be located in the field by providing suitable reference pillars for respective building/structures.

6.3.2 The contractor shall establish the safe load carrying capacity of each type of pile, as specified in GFC drawing, through initial pile load tests in vertical load test mode. For each test the safe load as derived from the initial load test results should not be less than the safe load carrying capacity in the respective mode as specified in GFC drawings.

6.3.3 It is envisaged that the working piles shall be installed after the successful completion of the initial pile load test. No working piles shall be installed before successful load test of initial test piles

6.3.4 If the routine pile load test on any working pile in a pile group fails to establish the specified safe load carrying capacity, the contractor shall rectify the shortfall in pile capacity of piles of the group as decided by the Engineer-in-charge, by installing additional piles and also constructing the extra (increased) size of the pile cap (due to additional piles) at the cost of the contractor.

- 6.3.5 The Engineer-in-charge reserves the right to reject any pile which in his opinion is defective on account of poor workmanship, structural integrity, position, alignment, concrete quality or any other reason. Piles which are defective shall be either pulled out by the contractor or left in place as directed by the Engineer, without affecting the performance of adjacent piles. The contractor shall install additional piles to substitute the defective piles, as per the directions of the Engineer-in-charge at no extra cost to the owner. Further, the cost of additional piles and increase in the pile cap size, if any, an account of additional piles shall be borne by the Contractor.
- 6.3.6 Each pile shall be identified with a reference number. The convenience of installation may be taken into account while scheduling the sequence of piling in a group.
- 6.3.7 The Contractor shall record all the information during installation of piles. Typical data sheet for recording pile data shall be maintained and got approved from the Engineer-in-charge. On completion of each pile installation, pile record in triplicate shall be submitted to the Engineer-in-charge within two days of completion of concreting of the pile.
- 6.3.8 Approval of termination depth by the Engineer-in-charge shall in no way absolve the Contractor of his responsibility to guarantee the 'safe load' capacities of the piles as indicated in this document.
- 6.4 **Installation/Termination Criteria of Bored - Cast-in-situ Pile**
- 6.4.1 The installation/termination level of the pile shall be as per the criteria elaborated in the requirements specified in Annexure-I.
- 6.4.2 Concreting shall not be done until the above conditions for installation of piles are satisfied.
- 6.5 **Control of Position and Alignment**
- 6.5.1 Piles shall be installed as accurately vertical as possible. The permissible limits for deviation with respect to position and (inclination) alignment shall conform to IS: 2911.
- 6.6 **Piling Equipment**
- 6.6.1 The equipment and accessories for installation of piles shall be selected giving due consideration to the sub soil conditions, ground water conditions, type of founding material etc. The cutting tool shall be suitable for the strata encountered (or) as approved by the Engineer-in-charge, if required the contractor shall consult the equipment manufacturer for selection of appropriate cutting tool and shall use/replace the same with no extra cost implications to the owner.
- 6.7 **Bored Pile**
- 6.7.1 Boring / drilling operations shall be done by rotary hydraulic drilling rigs / DMC. The cutting tool shall have suitable ports for the bentonite slurry circulation. The rotary drilling rig shall have suitable and adequate accessories for boring / drilling through all type of strata expected at site.

- 6.7.2 Working level shall be above the pile cut-off-level. After the initial boring of about 1m, temporary guide casing of suitable length shall be lowered in the pile bore. The diameter of guide casing shall be such as to give the necessary finished diameter of the concrete pile. The center line of guide casing shall be checked before continuing further boring. Guide casing shall be of minimum 3.0m length. Additional length of casing may be used depending on the condition of the strata, ground water level etc.
- 6.7.3 The temporary guide casing (if provided) shall be withdrawn cautiously, after concreting is done upto the required level. While withdrawing the casing, concrete shall not be disturbed.
- 6.7.4 The size of cutting tools shall not be less than the diameter of the pile by more than 75mm. However, the pile bore shall be of the specified size. Dimension/size of cutting tool shall be checked at least once in a month to have a watch on the reduction in size of cutting tool for wear and tear during boring.
- 6.7.5 In case hard rock is encountered and chiselling is essentially required for softening of the rock, the same may be adopted only on approval of the Engineer-in-charge, at no extra cost to the Owner. However, advancement of pile bore shall be done by drilling only.
- 6.7.6 Drilling mud (bentonite slurry) shall be used for stabilizing the sides of the pile bore. Drilling mud to be used shall meet the requirements, as given below.
- 6.7.6.1 Liquid limit of bentonite when tested in accordance with IS: 2720 (part v) shall be more than 300 percent and less than 450 percent.
- 6.7.6.2 Sand content of the bentonite powder shall not be greater than 7 percent.
- 6.7.6.3 Bentonite solution should be made by mixing it with fresh water using pump for circulation.
- 6.7.6.4 The marsh viscosity when tested by a marsh cone shall be between 30 to 60 seconds.
- 6.7.6.5 The differential free swell shall be more than 300 percent.
- 6.7.6.6 The pH value of the bentonite suspension shall be between 9 and 11.5.
- 6.7.6.7 Maintaining the bore hole : The bentonite slurry shall be maintained at least 1.5m above the ground water level during boring operations and till the pile is concreted. The bentonite slurry shall be under constant circulation till start of concreting and shall meet the requirements stipulated in the subsequent clauses.

While withdrawing the cutting tool during the pile boring operation, extra care shall be taken so that no suction is created on the sides or below the cutting tool slowly disturbing the adjoining soil. The cutting tool shall initially be withdrawn in short steps combined with slow rotation so as to allow air and bentonite slurry to flow below the cutting tool, thereby preventing any suction below.

6.7.6.8 Cleaning of Pile bore

- i) After completion of the pile bore up to the required depth, the pile bore shall be cleaned by two stage flushing of slurry using airlift technique i.e. after completion of boring and after placement of reinforcement cage but just before commencement of concreting. The bottom of the pile bore shall be thoroughly cleaned by airlift technique. The air pipe shall be as close as possible to bottom of pile bore and shall connect at right angle (a J-type metal pipe welded / fixed with the bottom segment of GI pipe/ tremie pipe) to GI pipe/tremie pipe at bottom from outside the GI pipe/tremie pipe, rather than being lowered straight inside the GI pipe/tremie pipe which will disturb the bottom of boring. The flushing shall be by the jetting action of air in the upward direction through the drilling tool or tremie pipe as the case may be. Cleaning shall ensure that the pile bore is completely free from sludge / bored material, debris of rock / boulder etc. Necessary checks shall be made so as to confirm the thorough cleaning of the pile bore.
- ii) Pile bore shall be cleaned by fresh drilling mud through tremie pipe before and after placing the reinforcement and just before the start of concreting.
- iii) Concreting operations shall not proceed if the contaminated drilling mud at the bottom of the pile bore possess a density of more than 1.25 t / cu.m. The drilling mud sample shall be collected from the bottom of pile bore. For this a solid cone shall be lowered by a string to the bottom of pile bore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimize the leakage, while lifting the cone assembly to the ground surface. The slurry collected in the sampler tube shall be tested for density.
- iv) Consistency of the drilling mud suspension shall be controlled throughout concreting operations in order to keep the bore stabilized, as well as to prevent concrete getting mixed up with the thicker suspension of the mud.
- v) A protocol shall be maintained as per the directions of Engineer-in-charge regarding the strata at the pile termination level, SPT value, percent core recovery, Unconfined Compressive Strength (UCS) from the nearest borehole, socketing horizon, time and duration of flushing of pile bore, time interval between end of boring and start of concreting, bentonite density before start of concreting.

6.8 Carriage and Disposal

6.8.1 Bored spoil material and contaminated mud shall be disposed by the contractor.

6.9 CONCRETING

- 6.9.1 Technical specification for cast-in-situ concrete and allied works along with IS: 2911 shall be applicable to concrete works for piles.
- 6.9.2 Minimum grade of concrete shall be M30. Minimum Cement content shall be 400kg / cum. or that determined from the mix design, whichever is higher.
- 6.9.3 The slump of concrete shall vary between 150 to 180 mm and 100 to 180mm for bored and driven piles respectively. Admixtures in concrete are not permitted for piles.
- 6.9.4 Concreting shall not be done until the Engineer-in-charge is satisfied that the termination level of pile satisfies the installation criteria mentioned elsewhere in the specification.
- 6.9.5 The time interval between the completion of boring / driving of casing tube and placing of concrete in pile bore shall not exceed 6 hrs. In case the time interval exceeds 6 hrs the pile bore shall be abandoned. However, the Engineer-in-charge may allow concreting provided the Contractor extends the pile bore by 0.5 m beyond the termination level and cleans the pile bore. The entire cost of all operation and Owner Issue Materials for this extra length shall be borne by the Contractor.
- 6.9.6 Concreting shall be done by tremie method. The operation of tremie concreting shall be governed by IS: 2911. A surge concrete of about 1 to 1.5 cum shall be done in the first pour by suddenly removing the closure plate provided at the bottom of funnel so as to displace completely the sludge/bored material/debris etc. from the bottom of pile bore. Drilling mud shall be maintained sufficiently above the ground water level as specified elsewhere in the specification.
- 6.9.7 It shall be ensured that volume of concrete poured is not less than the theoretically computed volume of the pile shaft being cast.
- 6.9.8 Continuous filling of concrete shall be ensured by minimum two numbers of transit mixers. The cold joints in the pile shall be avoided.
- 6.10 **Top of Concrete in Pile and Cut-off-Level (COL)**
- 6.10.1 Cut-off-Level of piles shall be as indicated in the GFC drawings released for construction and / or as indicated by the Engineer.
- 6.10.2 The top of concrete in pile as cast shall be above the cut-off-level by 1.0 meter (minimum) to remove all laitance and weak concrete and to ensure good concrete at cut-off-level, for proper embedment into the pile cap.
- 6.10.3 Cement being used for concreting this extra length of pile above the cut-off-level, as per the requirements of technical specification shall be considered as the material being used for the work, for the purposes of reconciliation of cement consumption, as per the provisions of special conditions of contract.
- 6.10.4 **Preparation of Pile head:** The area surrounding the piles shall be excavated upto the bottom of the pile caps. After seven days of concreting of pile, the exposed part of concrete above the COL shall be removed / chipped off and made rough at COL. The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored

into the pile-cap. The pile top shall be embedded into the pile cap by 75mm or clear cover to reinforcement, whichever is higher.

6.10.5 All loose material on the top of pile head after chipping to the desired level shall be removed and disposed of beyond the plant boundary or as directed by the Engineer-in-charge.

6.11 **REINFORCEMENT**

6.11.1 Technical specification for cast-in-situ concrete and allied works along with IS:2911 shall be applicable for reinforcement for piles.

6.11.2 Longitudinal reinforcement in pile shall be TMT Fe-550D reinforcement bars conforming to IS:1786-1985, unless specified otherwise. Lateral reinforcement in pile shall be of mild reinforcement conforming to IS: 432 Part-1 or HYSD bars as per IS: 1786-1985.

6.11.3 The longitudinal reinforcement shall project 50 times its diameter above cut-off-level unless otherwise indicated. Any excess length of pile reinforcement may be removed by gas cutting or by any other method approved by Engineer.

6.11.4 The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100 mm for the full depth of cage. For links, the spacing shall not be less than 150mm and in no case more than 250mm.

6.11.5 Proper cover to reinforcement and central placement of the reinforcement cage in the pile bore shall be ensured by use of minimum three circular cover blocks, cast specifically for the purpose. Concrete cover blocks shall be provided at a spacing not more than 1.5m c/c at the bottom ring and also be provided at the junction of the two segments of reinforcement cage. While lowering the reinforcement cage two hooks shall always be used to prevent tilting. Placement of reinforcement cage to its full length shall be ensured before concreting. The cage shall be suspended by means of 2 nos. of 12 dia. hanger bar supported from casing pipe.

6.11.6 Minimum clear cover to the reinforcement shall be as specified in the GFC drawings.

6.11.7 While lowering the reinforcement cage in two or more segments, lapping reinforcements shall be welded for suitable length to transfer the weight of lower segment to upper segment and also to arrest distortion of reinforcement cage. Helical links as well as inner rings shall also preferably be welded at the lapping portion, to ensure smooth lowering of reinforcement cage.

6.12 **BUILDING UP OF PILES**

6.12.1 If any pile, already cast as per construction drawing, requires any extra casting due to any change in cut-off-level, then the pile shall be built up by using at least one grade higher concrete than specified for piles, ensuring proper continuity with the existing concrete by adopting the measures specified for the construction joint between old concrete with fresh concrete in the cage -in situ concrete and allied works and to the satisfaction of the Engineer. Necessary reinforcement, as per design requirement and suitable shuttering shall be

provided, before casting the concrete. Surrounding soil shall also be built up to the required level by proper compaction, to ensure lateral capacity of the pile.

6.13 BREAKING OFF OF PILES

6.1.3.1 If any pile already cast requires breaking, due to subsequent change of cut-off-level, then the same shall be carried out, not before seven days of casting without affecting the quality of existing pile, such as loosening, cracking etc., and to the satisfaction of the Engineer-in-charge.

6.14 LOW STRAIN PILE INTEGRITY TEST

6.14.1 Low strain integrity test shall be conducted on all the working piles, on all test piles and as directed by the Engineer. The system shall have the computer readout facility and report on the findings of this shall be furnished to the Engineer. This test shall also be used to identify the piles for carrying out routine load test. The test equipment shall be of TNO or PDI make or equivalent. The process shall conform to ASTM D5882-00 and method of testing shall be Pulse Echo Method (PEM).

6.14.2 Piles shall be trimmed to cut-off-level or sound concrete level, whichever occurs later and as directed by the Engineer-in-charge. No pile cap work shall be undertaken prior to this test. The test shall be carried out after 21 days from the date of concreting for cast in situ piles. However, the Engineer may permit the test after 14 days in exceptional cases.

6.14.3 The test shall be undertaken through an independent specialist agency approved by Engineer. This test is limited to assess the integrity of the shaft such as imperfections or discontinuities and is not intended to replace the use of static load testing.

6.14.4 Methodology

6.14.4.1 In this test, a low stress wave is set up in the pile shaft and is also known as sonic integrity or sonic echo test.

6.14.4.2 A small metal / hard rubber hammer is used to produce a light firm blow on top of the pile. The shock wave travelling down the length of the pile is reflected back from the toe of the pile and recorded through a suitable transducer / accelerometer in a computer, for subsequent analysis.

6.14.4.3 Printout of the field data shall be submitted to the site Engineer once the test is completed and a report shall be submitted to the Engineer indicating the integrity of pile, pile length, velocity of wave through concrete etc within a week to the Owner. Further the contractor should submit the suggested list of piles for carrying out routine load tests. Then the contractor should finalise in agreement with owner, the piles for carrying out routine load tests.

6.15 LOAD TEST ON PILES

- 6.15.1 This part of the specification covers the requirements for initial and routine load tests on reinforced concrete single vertical piles of specified diameter to assess their vertical, horizontal (lateral) and pull out load carrying capacities.
- 6.15.2 The work shall include mobilisation of all necessary equipment, kentledge, anchor piles / rock anchors, or combination of kentledge and anchor piles / rock anchors, all associated enabling works, providing necessary engineering, supervision and technical personnel, skilled and unskilled labour, etc., as required, to carry out the complete pile testing and submission of test reports.
- 6.15.3 The Contractor shall carryout all works meant within this specification for successfully carrying out the pile load tests, even if not explicitly mentioned under the scope. All works shall be carried out to the satisfaction of the Engineer-in-charge.
- 6.15.4 All pile testing shall conform to IS: 2911(Part IV) and modified to the extent given below.
- (i) It is essential that all equipment's and instruments are properly calibrated both at the commencement and immediately after the completion of tests, so that they represent true values. If the Engineer-in-charge so desires, the Contractor shall arrange for having the instruments calibrated in presence of the Engineer-in-charge, at an approved laboratory at his cost and the test report / calibration certificate shall be submitted to the Engineer-in-charge.
 - (ii) The complete jacking system including the hydraulic jack, hydraulic pump and pressure gauge shall be calibrated as a unit. The complete unit shall be calibrated over its complete range of travel for increasing and decreasing loads same as that of test loads. The calibration certificate shall be submitted to the Engineer-in-charge.
 - (iii) The reaction load to be made available for the test shall be at least 25% greater than the maximum jacking force. The reaction system as relevant shall be designed for the total reaction load. All reaction loads shall be stable and balanced during all operations of testing. During testing, stability of reaction system shall be ensured.
 - (iv) The load applied on the pile shall be measured by a calibrated pressure gauge mounted on the jack with a least-count of not more than 10% of the safe load.
 - (v) The displacement of pile (in vertical, horizontal and uplift) shall be measured using LVDT's having a least count of 0.01mm.
 - (vi) Load test shall be conducted at pile cut of level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively, the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter.
 - (vii) Full details of the equipment proposed to be used, the test setup and pile testing scheme along with detailed design, drawings shall be submitted to the Engineer,

before making arrangements to carry out the tests, for his approval. Approval of the Engineer-in-charge shall also be obtained after the test set up is complete prior to commencement of loading.

- (viii) All operations in connection with pile load test shall be carried out in a safe manner to ensure the safety of man and material.
- a) Proforma for pile load tests shall be got approved and shall be submitted in triplicate to the Engineer-in-charge immediately on completion of each test. The record shall also include the plots of (i) load vs settlement and (ii) time vs settlement (for each increment of Load), (iii) characteristics of the piles and interpretation of the pile load test curve as per the criteria for safe loads, as mentioned in the specification. The copy of details of the test pile from pile log book shall also be included in the report of the pile load test.
- (ix) If any initial pile load test gets abandoned and / or is not successfully completed then the Contractor shall install another test pile and repeat the initial test after correcting the fault, at his own cost.

6.16 Test Pile Installation

6.16.1 Test Piles shall be installed as per the directions of Engineer-in-charge.

6.16.2 Pile installation data as applicable shall be furnished along with the load test results in triplicate, to the Engineer-in-charge.

6.17 Type of Pile Load Tests

6.17.1 The Contractor shall carry out two categories of load tests i.e. initial load test and routine load test. Initial load test shall be conducted to assess the safe load carrying capacity of pile before start of installation of working Piles. This shall include the following type of tests.

- a) Maintained load test to assess safe vertical load capacity.

6.17.2 Routine load tests shall be conducted to verify the load carrying capacity of working pile. This shall include the following types of tests:

- a) High Strain Dynamic Pile load test for vertical load capacity.
- b) Direct vertical (compression) load test for vertical load capacity

6.17.3 The minimum number of routine load test on working piles shall be as given in BOQ and as directed by Engineer-in-charge. The results of direct routine vertical load test shall also be used for correlation with the results of High Strain Dynamic load test.

6.18 Test Pile

6.18.1 All testing of piles shall be done in accordance with the latest issue of IS code 2911 Part-IV.

LIST OF CODES

The materials and workmanship shall be in accordance with the requirement of the appropriate IS code wherever applicable together with any building regulations or bye-laws governing the works.

The following list is included for guidance only and the omission from the list does not relieve the contractor from compliance therewith :

IS 269	:	Ordinary Portland cement.
IS 3812, 1981	:	Flyash for use as pozzolana and admixtures,
IS 2386	:	Method of test for aggregate for concrete.
IS 516	:	Method of test for strength of concrete
		Coarse and fine aggregate from natural sources for concrete.
IS 1077, 1970	:	Method of test for Bricks.
IS 456	:	Code of practice for plain and reinforced concrete.
IS 6313 PART 2	:	Anti-termite measures in buildings, pre-constructional chemical treatment measures.
IS 2571	:	Code of practice for laying in situ cement concrete flooring
IS : 226	:	Structural Steel (Standard Quality)
IS : 800	:	Code of Practice for Use of Structural Steel in General Building Construction
IS : 806	:	Code of Practice for Use of Steel Tubes in General Building Construction
IS : 813	:	Scheme of Symbols for Welding
IS : 814	:	Covered Electrodes for Metal Arc Welding of (part I & II) Structural Steel
IS : 816	:	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel
IS : 822	:	Code of Practice for Inspection of Welds
IS : 961	:	Structural Steel (High Tensile)
IS 104	:	Specification for ready mixed painted, brushing, zinc chrome, priming.

CIVIL WORKS

1.0 GENERAL

- 1.1** The Contractors are advised to inspect and examine the site and its surroundings and satisfy themselves with the nature of site, the means of access to the site, the constraints of space for stacking material / machinery, labour etc., constraints put by local regulations (if any), weather conditions at site (rainfall, snowfall, winter / summer temperatures etc.), general ground / subsoil conditions etc. or any other circumstances which may affect or influence their tenders. No claims, whatsoever, shall be entertained at a later date for any errors found, on plea that the information supplied by the Department in the tender is insufficient or is at variance with the actual site conditions.
- 1.2** The work shall be carried out, all in accordance with true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and/or described in the specifications, provided that the same can be reasonably inferred. There may be several incidental works, which are not mentioned in the nomenclature of each item but will be necessary to complete the item in all respect. All these incidental works / costs which are not mentioned in specifications/drawings/tender document but are necessary to complete the item shall be deemed to have been included in the rates quoted by the contractor. No adjustment of rates shall be made for any variation in quantum of incidental works due to variation / change in actual working drawings. Also, no adjustment of rates shall be made due to any change in incidental works or any other deviation in such element of work (which is incidental to the items of work and are necessary to complete such items in all respects) on account of the directions of Engineer-in-Charge. Nothing extra shall be payable on this account.
- 1.3** The work shall generally be carried out in accordance with the "CPWD Specifications 2019 Vol. I & II" with correction slips up to last date of submission of bid (including any extension in last date of bid submission), additional / Particular Specifications, Architectural / Structural drawings and as per instructions of Engineer-in-Charge. Any additional item of work, if taken up subsequently, shall also conform to the relevant specifications mentioned above.
- 1.4** The several documents forming the tender are to be taken as mutually complementary to each other. Detailed drawings shall be followed in preference to small scale drawings and figured dimensions in preference to scale dimensions. Between two or more Clauses of this Contract, the provisions of a specific Clause relevant to the issue under consideration shall prevail over those in other Clauses.
- 1.5** The work shall be carried out in accordance with the Architectural drawings and Structural drawings, to be issued by the Engineer-in-Charge. Before commencement of any item of work, the contractor shall correlate all the relevant architectural, structural and services drawings issued for the work and satisfy himself that the information available there from is complete and unambiguous. The discrepancy, if any, shall be brought to the notice of the Engineer-in-Charge before execution of the work. The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and or incomplete information.
- 1.6** Wherever any reference to any Indian Standards occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued thereto or revisions thereof, if any, up to the last date of receipt of tenders (including extended date, if any).
- 1.7** Wherever required for the execution of work, scaffolding shall be provided and suitably fixed, by the Contractor. The contractor shall provide steel double scaffolding system, suitably braced for stability, with all the accessories, gangways, etc. with adjustable suitable working platforms to access the areas with ease for working and inspection. It shall be designed to take all incidental loads. It should cater to the safety features for workmen. Nothing extra shall be payable on this account. It shall be ensured

that no damage is caused to any structure due to the scaffolding.

The contractor may be allowed to erect labour huts on the plot without disturbing the construction area. However, the contractor shall make his own arrangements to provide for additional accommodation, if required (in addition to available area at site), as per the rules of the local bodies. He shall make his own arrangements for stores, field office etc. Before tendering, he shall visit the site and assess the manner in which he is able to arrange the above facilities. The Engineer-in- Charge shall in no way be responsible for any delay on this account and no claim, whatsoever, on this account shall be entertained. Nothing extra shall be payable on this account.

- 1.8** The contractor(s) shall take all precautions to avoid accidents by exhibiting necessary caution boards day and night. The contractor shall ensure entire necessary precaution during the entire period of work and site related activities to ensure full safety to workers and avoid any kind of accident. In case of any accident of labour's/ contractual staffs or any other human being the entire responsibility will rest on the part of the contractor both legally and financially and any compensation under such circumstances, if becomes payable, shall be entirely borne by the contractor.

1.9 DE-WATERING

- i De-watering required, if any, shall be done conforming to BIS Code IS: 9759 (guide lines for de-watering during construction) and / or as per the specifications approved by the Engineer- in-Charge. Design of an appropriate and suitable dewatering system shall be the Contractor's responsibility. Such scheme shall be modified / augmented as the work proceeds based on fresh information discovered during the progress of work. At all times during the construction work, efficient drainage of the site shall be carried out by the Contractor and especially during the laying of plain cement concrete, taking levels etc. The Contractor shall also ensure that there is no danger to the nearby properties and installations on account of such lowering of water table. If needed, suitable precautionary measures shall be taken by the Contractor. Also, the scheme of dewatering adopted shall have adequate built in arrangement to serve as stand- by to attend to repair of pumps etc. and disruption of power / fuel supply.
- ii In trenches where surface water is likely to get into cut / trench during monsoons, a ring bund of puddle clay or by any other means shall be formed outside, to the required height, and maintained by the Contractor. Also, suitable steps shall be taken by the Contractor to prevent back flow of pumped water into the trench. Nothing extra shall be payable on this account.
- iii The Agency shall be responsible for taking necessary approval for the discharge of the water. Nothing extra shall be payable on this account.

1.10 STRUCTURAL SAFETY

Following guidelines to be followed where height of casting of concrete is higher than 3.5 m or where higher loading are coming during casting of concrete or large span structure more than 5 meter long or some special structure like domes, vaults, steel structure etc.

- I. Centering / scaffolding / staging for casting of these structures should be properly designed by a qualified and experienced person/agency having past experience in design of false work (centering) for concrete structures and should be proof checked by similar experienced person/agency and it should be approved by Engineer-in-Charge. The provisions of clause 7 of IS: 14687 may be referred for design of

false work (centering).

- II. A method statement for erection and dismantling of the centering/scaffolding/staging and process of concreting & process of anchor of steel structure shall be prepared by contractor and submitted to Engineer-in-Charge for approval and the work shall be commenced only after approval of method statement by Engineer-in-Charge. The provisions of clause 9 of IS: 14687 may be referred for erection of false work (centering), safety precautions and other site operations, pertaining to false work (centering).
- III. Engineering form watcher shall be engaged during erection, concreting and dismantling for early detection of any movement or instability in the system.
- IV. A detailed programme of field safety inspection of centering/scaffolding/form work of such structures during different stages should be chalked out and strictly followed.
- V. The prime responsibility of safety of false work shall with contractor for concrete and structural steel work.
- VI. Provision of safety net, fall arresting system including other safety gears, for workers, working over these structures shall be followed strictly.

1.11 OTHER CONDITIONS W.R.T EXECUTION OF WORK

- a. The work shall be carried out in accordance with the contract specification/terms, tendered drawings and detailed drawings including revised drawings, if any, issued during execution of work by the Engineer-in-Charge.
- b. Before commencement of any item of work, the contractor shall correlate all the relevant architectural, structural and MEP drawings, and specifications etc. issued for the work and satisfy himself that the information available there from is complete and unambiguous. The figure and written dimension of the drawings shall be superseding the measurement by scale. The discrepancy, if any, shall be brought to the notice of the Engineer-in-charge before execution of the work. The contractor alone shall be responsible for any loss or damage occurring by the commencement and execution of work based on any erroneous and or incomplete information and no claim whatsoever shall be entertained on this account.
- c. The contractor is required to deploy resources as per availability of site. However, no claim will be entertained for idle labour, idle machinery, idle technical/no-technical staff, idle T&P etc.
- d. The work of services will be executed simultaneously. The Contractor shall minimize the scope of making recesses, holes, opening etc. as the same shall be planned in advance and necessary grooves/niches shall be provided in shuttering of RCC.
- e. The Aluminium door-windows-framework, lamination and Lipping on flush doors shall be factory made.
- f. Unless otherwise specified , wherever mild steel / galvanized iron sections and pipes are provided in the work, priming coat of approved steel primer shall be done after removing rust from section if any and finally finished with low VOC synthetic enamel paint or as mentioned specifically in specification.
- g. Fall nets and scaffolding nets for protection from debris / dusts and noise etc. are to be provided during the construction period.
- h. If details for any area/space w.r.t. finishing schedule, door & window schedule, sanitary fitting schedule, hardware schedule etc. are not mentioned in the particular specification/schedules/ drawings,

the details of area/space having similar functionality shall be followed.

- 2.0 It is intended to make our built environment barrier free and accessible to all. Bidders are instructed to strictly adhere to the provision contained in Hand Book on Barrier free and accessibility containing and corresponding provisions of NBC 2016 while incorporating such features in the building. Nothing extra shall be payable on this account.

3.0 Cement

- 3.1** Unless otherwise specified in this document, PPC cement shall be used except for RCC work and Design Mix concrete. Agency shall procure OPC conforming to IS : 8112 / PPC conforming to IS : 1489 (Part 1) as required in the work from cement manufacturers mentioned in the list of Preferred makes for civil works or from any other reputed cement manufacturer having a production capacity not less than 1 million tons per annum as approved by competent authority. Uses of GGBS /Fly ash with OPC is permitted as per norms.
- 3.2** The supply of cement shall be taken in 50 kg. bags bearing manufacturer's name and ISI marking. Samples of cement arranged by the Contractor shall be taken by the Engineer-in-charge and got tested in accordance with provisions of relevant BIS codes. In case the test results indicate that the cement arranged by the Contractor does not conform to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the Contractor at his own cost within a week's time of written order from the Engineer- in-charge to do so. Supply of cement shall be taken in 50-kg bags bearing manufacturer's name, or his registered trademarks if any and grade and type of cement as well as ISI marking.
- 3.3** The cement shall be brought at site in bulk supply of approximately 50 tons or as decided by the Engineer-in-charge on the basis of requirement of work in progress. The cement godowns of Minimum 2x5000 bags capacity to store the cement shall be constructed by the Contractor at site of work.
- 3.4** Double lock provision shall be made to the door of the cement godowns. The keys of one lock shall remain with the engineer-in-charge or his authorised representative and the keys of other lock shall remain with the contractor. The contractor shall be responsible for the watch and ward and safety of cement godowns. The contractor shall facilitate the inspection of cement godowns by the Engineer-in-charge at any time.
- 3.5** The cement shall be got tested by the Engineer-in-charge and shall be used on the work only after satisfactory test results have been received.
- 3.6** The actual issue and consumption of cement on work shall be regulated and proper accounts shall be maintained. The theoretical consumption of cement shall be worked out. In case the cement consumption is less than theoretical consumption including permissible variation, recovery at the rate so prescribed shall be made. In case of excess consumption, no cost adjustment shall be made.
- 3.7** The cement brought to the site and the cement remaining unused after completion of the work shall not be removed from site without the written permission of the Engineer-in-charge.
- 3.8** The damaged cement shall be removed from the site immediately by the Contractor on receipt of a notice in writing from the Engineer-in-charge. If he does not do so within 3 days of receipt of such notice, the Engineer-in-charge shall get it removed at the cost of the Contractor.

4.0 Steel Reinforcement

- 4.1** The Contractor shall / procure ISI marked TMT Fe-550D bars of various dia from the Steel Manufacturers mentioned in preferred make list for civil works or their authorized dealers/ authorized distributors/channel partners.

- 4.2 Samples shall also be taken and got tested by the Engineer-in-Charge as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the contractor does not conform to the specifications, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his cost within a week time or written orders from the Engineer- in-Charge to do so.
- 4.3 The steel reinforcement bars shall be brought to the site in bulk supply of 25 tonnes or more, or as decided by the Engineer-in-charge.
- 4.4 The steel reinforcement bars shall be stored by the contractor at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.
- 4.5 The contractor shall supply free of charge the steel required for testing including its transportation to testing laboratories.
- 4.6 The actual issue and consumption of steel on work shall be regulated and proper accounts maintained. The theoretical consumption of steel shall be worked out. In case the consumption is less than theoretical consumption including permissible variations, recovery at the rate so prescribed shall be made. In case of excess consumption, no adjustment needs to be made.
- 4.7 The Steel brought to site and remaining unused shall not be removed from site without the written permission of Engineer-in-Charge.
- 4.8 The contractor shall submit original vouchers from the manufacturer for the total quantity of steel supplied under each consignment to be used in the work. All consignment received at the work site shall be inspected by the Site staff along with the relevant documents before acceptance. The contractor shall obtain Original Vouchers and copy of Test Certificates and furnish the same to the Engineer-in-Charge in respect of all the lots of steel brought by him from approved supplier to the site of work. The original vouchers and copy of test certificates shall be defaced by the Site staff and kept on record in the site office.
- 4.9 The reinforcing steel brought to site of work shall be stored on brick / timber platform of 30/40-cm height, nothing extra shall be paid on this account.

5.0. SEISMIC / EXPANSION JOINT:

The vertical & horizontal expansion joints shall be treated as per the relevant IS code and CPWD specifications. The system shall comply the specification mentioned herein.

- 5.1. EXTERIOR WALL EXPANSION JOINT SYSTEM: It includes providing & fixing of the Wall to Wall Expansion Joints system (WTC 400/300- Wall Model of width specified in structural drawings. It shall be manufactured from the Aluminum Alloy 6063 - T66. The Expansion Joint Covers/Profile shall be supplied in 3/ 4 Metre Cut - Length. Aluminum Covers/Profiles, should have a Hard Wearing, Maintenance Free, long Lasting design. The Expose surface of the model should have an Anodized/Mill Finish. The design of the Expansion Joint Cover System should have a Centering bar that allows and accommodate the Multi- dimensional movement capabilities. The system must comply Cycle Movement Test as per ASTM - 1399 Part 4. Test Certificate has to be mandatorily submitted along with Supplies. The total & visible width of the Expansion Joint would be as per manufacturer's specifications. The Expansion Joint System will have side Profile/Mounting bracket allowing for secure fixing and Flexible anchoring of the system to the Vertical Surface. Fire Barrier (UL Certified) as specified and per the Manufacturer's Standards shall be used/Installed before installation of the Expansion Joint Cover. Exterior Wall Expansion Joint Covers/Models shall have a mandatory Installation of Moisture / Water Proofing of the Expansion Joint by the way of Sealing the Joint with the additional Membrane with Epoxy sealing agent & other means i.e., the Anchor fasteners in the Exterior elevation Wall or on the Exterior Façade System of the building will have to done in order to prevent of any water seepages during rain or by other possibilities.
- 5.2. FLOOR EXPANSION JOINT SYSTEM: It includes providing & fixing of the floor expansion joint system (SPJ

400/300 Floor Pan joint system) of width specified in structural drawings. It shall be manufactured from the Aluminum Alloy 6063 - T66. The Expansion Joint Covers/Profile shall be supplied in 3/ 4 Metre cut – Length. Aluminum Covers Profiles should have a Hard Wearing, Maintenance Free, long lasting design. The design of the Pan should be such that there is no requirement of the diagonal cutting of the infill i.e., stone & tiles. The Expose surface/Edge of the pan model should have a visible width of 65 mm (+/-5%) & Serrated Surface, which should ensure to have a good Skid Resistance so that it avoids any kind of Slippages during its usage. The design of the Expansion Joint Cover System should be such that it should pop up with the infill in case of earthquake when the closure of Joint width happens during earthquake. The Expansion Joint Cover should have a Centering bar that allows and accommodate the Multi- dimensional movement capabilities. The system must comply Cycle Movement Test as per ASTM – 1399 Part 4. Test Certificate has to be mandatorily submitted along the with Supplies. The total width of the Expansion Joint shall be as per manufacturer’s specifications. The system can be used for standard pedestrian loads & Cart-Wheel Loads if required. The Side Profile should have a MULTI HOLE mounting bracket allowing for secure fixing and Flexible anchoring and excellent

bonding with given slab surface/masonry/epoxy bedding. For Precise Transitions, the factory supplied slid-in connection pins should be used during the installation of the cover system in multiple Cut-Length for achieving the Straight-line alignment. Water Proofing of the Expansion Joint by the way of sealing the Joint with the additional Membrane with Epoxy sealing agent will have to be done. Fire Barrier (UL Certified) as specified and per the Manufacturer's Standards shall be used/Installed before installation of the Expansion Joint Cover.

5.3. ROOF COVER EXPANSION JOINT SYSTEM :

5.3.1 FIRE BARRIER: Contractor shall be responsible for providing & fixing of fire seal/barrier for all expansion joint systems. The Fire barrier should be constructed by the use Alkaline Earth Silicate wool product in Stainless Steel encasing which should have a UL Certification for minimum of 2 Hrs. The Fire Barrier shall be supplied in Various Cut-Length depending on the Joint Width in Roll Form. The Fire barrier should be Asbestos Free for health & safety reasons/standards. The ANSI/UL 2079 Standards should be followed i.e. "Tests for Fire Resistance of Building Joint System". Both the Edges of the Stainless Steel encase should be welded by the Seam Welding Process, so that it gives flexibility during the Installation. As per site condition Surface Mounting Flanges can be provided or the same can also be secured along with the Anchors / Fasteners of the Multi Hole Mounting Brackets of the Exp. Joint Covers. The Fire barrier should have a 100 % Movement of the Joint width (+) 50 % / (-) 50 % at least in order to provide the Unhindered Expansion & Seismic Movement of the Mechanical/Metal Expansion Joint Covers. The system must comply Cycle Movement Test as per ASTM - 1399 Part 4. Test Certificate has to be mandatorily submitted along the with Supplies. The UL Certificate should be in the name of the Manufacturer of the Expansion Joint Cover System. It should be properly / safely stored in the Confined & shaded area so that it is well protected from the Sun & Rain / Water Contact & should be unboxed only before the Installation of them. Once Installed the Metal / Mechanical Expansion Joint Covers are to be Installed Immediately on above the Fire barrier in order to prevent any sort of damages from the Construction debris or otherwise.

6.0 MASONRY WORK:

The masonry work shall be done as per CPWD Specifications 2019, Volume-I & II with revisions / amendments / correction slips upto last date of bid submission (including extensions if any). In case of conflict or contradiction between detailing shown in drawings and specification mentioned herein under this subhead, the specification mentioned herein under this subhead will be followed.

- 6.1 AAC blocks masonry shall be of Grade I and of oven dry density 551-650 kg/cum with cement mortar (1 cement:4 coarse sand) above plinth level except wet areas.
- 6.2 Dimensions & Tolerances: Autoclave Aerated Concrete Block shall be made in sizes and shapes to fit different needs.
- 6.3 The maximum variation in the length of the Autoclave Aerated Concrete Block shall not be more than plus/minus 5mm and maximum variation in the height and width of Autoclave Aerated Concrete Block, not more than plus/minus 3mm.
- 6.4 The faces of Autoclave Aerated Concrete Block shall be flat & Rectangular, opposite faces shall be parallel and all arises shall be square. The bedding surfaces shall be at right angle to the face of the Blocks. The Autoclave Aerated Concrete Block with special faces shall be manufactured and supplied if so required.
- 6.5 The autoclaved Autoclave Aerated Concrete Block shall be classified in two grades according to their compressive strength as indicated in table below:

S.N.	Density in Oven dry Condition (Kg/m3)	Compressive Strength (N/mm2)		Thermal Conductivity in air dry condition (W/m.k)
		Grade I	Grade II	
1	451 to 550	2.00	1.50	0.21
2	551 to 650	4.00	3.00	0.24
3	651 to 750	5.00	4.00	0.30

4	751 to 850	6.00	5.00	0.37
5	851 to 1000	7.00	6.00	0.42

- a) All Autoclave Aerated Concrete Block shall be sound, free of cracks or other defects which interfere with the proper placing of block units impair the strength or performance of the construction. Where block units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks or other imperfections except that if not more than 5% of a consignment contains slight cracks or small chippings not larger than 25mm, this shall not be deemed grounds for rejection.
- b) **Block Density** – The Block density shall conform to the requirements specified in above table, when tested accordance with IS 6441 (Part-1) -1972.
- c) **Compressive Strength** – The min. compressive strength being the average of twelve block units shall be as prescribed in above table, when tested accordance with accordance with IS 6441 (Part-5) -1972.
- d) **Thermal Conductivity** – The thermal conductivity shall not exceed the values specified in above table when tested accordance with IS 3346 -1980.
- e) **Drying Shrinkage** – The drying shrinkage shall be not more than 0 .05% for grade -1 block and 0.10% for grade-2 block when tested accordance with IS 6441 (Part-2) -1972.
- f) **Number of tests:** A sample of 24 blocks shall be selected at random. All the 24 Blocks shall be checked for dimensions and inspected for visual defects. Out of the 24 blocks, 12 blocks shall be subjected to the test for compressive strength, 3 blocks to the test for density, 3 blocks to the test for thermal conductivity and 3 blocks to the test for drying shrinkage. The remaining 3 blocks shall be reserved for re-test for drying shrinkage if a need arises.
- g) The samples of AAC blocks (each sample consisting of 6 specimen) shall be chosen randomly from the lot procured and tested for various parameters specified as above. One samples shall be tested for every **200 cum** or part thereof. However, minimum one sample shall be tested from each lot received at site if the quantity procured in the lot is less than 200 cum. If required, Engineer-in-Charge or his authorized representative shall inspect the factory during production of the material for this work and also collect samples (of materials used for making AAC blocks and precast AAC blocks) from the factory itself. The contractor shall consider this contingency also while placing the order with one of the approved firms. Nothing extra shall be payable on this account.
- h) **Criteria for conformity:** The number of blocks with dimensions outside the tolerance limit and or with visual defects, among those inspected, shall not be more than two. For density, the mean value shall be within the range as specified in above Table.

For compressive strength, the mean value, say X shall be determined. The test results shall be grouped into groups of 4, individual values of ranges shall be determined, the average range a calculated from these values and shall satisfy the following condition: $X - 0.6 R >$ minimum value specified in above Table. For thermal conductivity, the mean value shall be equal to or less than the value specified in above Table. For drying shrinkage, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All these blocks shall satisfy the requirements.
- i) **Manufacturer's Certificate:** The manufacturer shall satisfy himself that the masonry units conform to the requirements of this specification and, if requested, shall supply a certificate to this effect to the purchaser or his representative.
- j) **Marking :** Each lot of concrete masonry units manufactured in accordance with this specification shall preferably be marked with information-

- The identification of the manufacture
- The grade and block density of the unit
- The month and year of manufacturing

7.0 WOOD WORK- (Laminated flush door shutters)

The wood work in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with revisions/ amendments / correction slips upto last date of bid submission (including extensions if any). In case of conflict or contradiction between detailing shown in drawings and specification mentioned herein under this subhead, the specification mentioned herein under this subhead will be followed. The detailing shown in door and window drawings are suggestive only. Before taking up any procurement/construction activity, shop drawings (for fixing of all kind of doors, showing all hardware's) shall be prepared (on the basis of specification laid herein) and submitted by contractor for obtaining approval from Engineer-in-Charge.

- 7.1 The samples of species of timber to be used shall be deposited by the contractor with the Engineer- in-Charge before commencement of the work. The contractor shall produce cash vouchers and certificates from standard kiln seasoning plant operator about the timber to be used on the work having been kiln seasoned by them, failing which it would not be accepted as kiln seasoned. Specified timber shall be of good quality and well-seasoned. It shall have uniform colour, reasonably straight grains and shall be free from dead knots, cracks and sapwood.
- 7.2 Laminated flush door factory made sample shall be provided at site before placing order in bulk.
- 7.3 Wood work shall not be painted, oiled or otherwise treated before it has been approved by the Engineer-in-Charge. All portion of timber including architrave abutting against masonry concrete stone or embedded in ground shall be painted with approved wood preservative or with boiling coal tar.
- 7.4 Door schedules is provided with the tender document which shall be followed invariably. If any door type or tag is not mentioned in drawings or door & window schedule, decision shall be given by Engineer in charge based on door suggested in door & window schedule for similar functional area.

All fittings and fixtures shall be as per hardware schedule for doors / windows (mentioned in tender document) and got approved from the Engineer-in-Charge before procurement well in advance and the approved samples shall be kept at site till completion of the work.

8.0 FIRE RATED DOOR AND DOORSET:

In general, all the services / electrical rooms / shafts shall be provided with Metal Fire Rated doors whereas all the lobbies, entry / exit to corridors shall be provided with the Glazed fire rated doors. Rooms opening in fire exit corridors may be provided with wooden fire rated doors. In case of any deviation is found between general principle mentioned herein and Fire check doors shown in architectural drawings (or mentioned door & window schedule), the former i.e. general principle (mentioned herein) will be followed. If any door type or tag is not mentioned in drawings or door & window schedule, decision shall be given by Engineer in charge based on principles mentioned herein. Before taking up any procurement/construction activity, shop drawings (for fixing of all kind of doors, showing all hardware's) shall be prepared and submitted for obtaining approval from Engineer-in-Charge. Fire rated doors and doorset shall comply with NBC-2016, para 2.22 and IS Code 3614:2021 with minimum fire rating of 120 minutes.

- 8.1 The Fire rated Door should not collapse during the rated period of the fire under specified fire conditions. The fire door should not allow the passage of hot gases or the flames through the rebate or the gap between the door frame and shutter. The integrity or smoke sealing function is achieved by Fire Door by incorporating an "Intumescent Seal". This Intumescent Seal in the form of a strip, which under fire conditions expands many times its original size and forms a hard char which has high insulation properties and does not permit the smoke or flames to escape through the gap between the shutter and frame.
- 8.2 Observation, if any, made by the fire officer on the fire rated doors, shall be incorporated suitably.

- 8.3 Execution of Fire Check Doors shall be carried out through the Specialized Agencies having sufficient work experience in the same field and shall be got approved from the Engineer-in-Charge well in advance. Specialized firm shall furnish all materials, labour, accessories, equipment, tool and plant and incidentals required for providing and installing the fire check / rated doors. Contractor has to select one specialized agency from list of preferred makes/brands and specialized agencies.
- 8.4 Fire resistance and smoke check doors shall be made of proper sizes and section as per the available opening at the site. The details shown on the drawings indicate generally the sizes of components parts and general standards. These may be varied slightly to suit the standard adopted by the manufactures. Before proceeding with manufacturing, the contractor shall prepare and submit complete manufacture and installation drawing for approval of the Engineer-in-Charge and no work shall be performed until the approval of these drawings is obtained.
- 8.5 The term "Fire Rating" referred in tender documents means fire rating of complete assembly of fire check door e.g. frames, shutter, Vision Panel, Glass, Hinges and other hardware's. Doors will be approved only after door passes the required tests from fire testing lab approved by the Engineer-in-Charge. Cost of sample door and testing shall be borne by contractor.
- 8.6 Doors shall be fabricated to size in factory. Fabricated material shall be protected against any damage during transportation. Loading and unloading shall be carried out with utmost care. On receipt of material at site it shall be carefully examined to detect any damaged units/members. Arrangements shall be made for expeditious replacement of damage units or members. Materials found acceptable on inspection shall be repacked in crates and stored safely.
- 8.7 Just prior to installation, the doors shall be uncarted and stacked on edge on level bars and supported evenly. The frame shall be fixed into position true to line and level using adequate number of fasteners of approved size and manufacture and in an approved manner. The holes in concrete /masonry member for housing anchor bolts shall be drilled with an electric drilling machine only.
- 8.8 Stainless steel ball bearing hinges, panic bars, door trims, fire rated hydraulic door closers, handles, tower bolts, lock and other fittings shall be as per hardware schedule for doors & windows provided in tender document and shall be got approved from Engineer-in-Charge. All Hardware's should have a minimum 02 Years of manufacturer warrantee from the date of supply. Hardware's should pass European certificate "CE" of conformity / UL certified with required fire ratings and relevant documents to this effect shall be produced at the time of approval of samples.
- 8.9 The design of fire rated doors and material to be used in their construction have to be such that the doors shall be capable of providing an effective barrier of desired rating.
- 8.10 Glazed Fire Rated Doors / Window / Partition -
- 8.11 Metal Fire Rated Doors-
Metal Fire door shall be from ISO 9001:2015 certified manufacturer. The door must have been manufactured with galvanised - GI sheet of GPSP Grade as per IS 277. All Fire doors must satisfy the requirement of latest NBC 2016 Part 4 for Fire & Life Safety guidelines. The Prototype sample of the door must carry a prior test evidence as per IS 3614 part-2 / BS 476 Part 20 & 22. The manufacturer must submit the copy of test evidence prior to start of reduction offered test certificate should either carries its Validity or certificate must not be older than 5 years from CBRI / NABL Accredited Lab. All doors should be finished with Powder coating (minimum 60 micron) in desired regular RAL Shades.

9.0 ALUMINIUM WORK:

- (a) Before taking up any procurement/construction activity, shop drawings (for fixing of all kind of Aluminum Works, showing all hardware's) shall be prepared and submitted for obtaining approval from Engineer-in-Charge.
- (b) Minimum weight of aluminium section for door, windows and ventilators shall be as per relevant standards.

- (c) Kiln seasoned hard wood shall be filled inside door frames on hinged side and top of frames wherever hydraulic door closers are to be provided.
- (d) Frames shall be fixed with dash fastener of minimum size 10 x 100 mm as per approved shop drawings.
- (e) Gap between aluminium frame window and adjacent RCC / masonry work shall be filled by providing weather silicon sealant over backer rod of approved quality as per direction of Engineer-in-Charge.
- (f) The material for the work shall be procured from the approved manufacturer as per preferred make list for materials in this contract agreement. The Contractor shall procure and submit samples of various materials to be used in the work for the approval of Engineer-in-Charge and no work shall commence before such samples are approved. Samples of un-anodized as well as polyester powder coated aluminium sections, microwave cured EPDM gaskets, glass, stainless steel screws, anchor fasteners, hardware and any other material or components requiring approval of samples, in opinion of Engineer-in-Charge, shall be submitted for the approval as mentioned above. The above samples shall be retained as standards of materials and workmanship.
- (g) Aluminium sections to be used for various works shall be appropriate to meet technical, structural, functional and aesthetic considerations. Aluminium work for doors, windows, ventilators and partitions etc. shall be with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. Polyester powder coated aluminium (minimum thickness of polyester powder coating 50 micron) section shall be used. Hinges/ pivots, provision for fixing of fittings, EPDM rubber / neoprene gasket shall be provided wherever required. The polyester powder coating shall be carried out in a factory / workshop approved by engineer-in-charge.
- (h) Glass in Windows/Ventilators: Glazing in aluminium windows, ventilators and partition etc. shall be Double glazed hermetically sealed with 6 mm thick toughened glass both sides, having 12 mm air gap, including providing EPDM gasket, perforated aluminium spacers, desiccants, sealant (Both primary and secondary sealant) etc. as per specifications, drawings and direction of Engineer-in-charge complete. The DGU unit shall have visible Light transmittance (VLT) of minimum 65%, Light reflection internal - less than or equal to 23%, Light reflection external - less than or equal to 23 %, SHGC- less than or equal to 0.6 and U value - less than or equal to 2.5 W/m² degree K.
- (i) Mortice Latch & lock: It shall be of Brass 100 mm mortice latch and lock with 6 levers without pair of handles (best make of approved quality) for aluminium doors.
- (j) Fabrication: The factory for fabrication and coating of aluminium windows/doors/frameworks shall be got approved from Engineer-charge. The fabrication unit should have experience of having done similar work of similar cost in 7 years prior to date of submission of proposal by contractor.
- (k) All joints shall be accurately fabricated and be hairline in appearance. The finished surface shall be free from visible defects. All the aluminium windows/ventilators/doors shall be factory made and shall be brought to site for assembly and fixing.
- (l) All hardware used shall conform to the relevant specifications mentioned in door window hardware schedule and as per samples approved by the Engineer-in-Charge. Design, quality, type, number and fixing of hardware shall be generally in accordance with shop drawings and as approved by the Engineer-in-Charge before use.
- (m) All doors, windows, ventilators and glazing etc. shall be made water tight with microwave cured EPDM gaskets and weather silicone sealants to the satisfaction of the Engineer-in- Charge.

(n) The frames shall be strictly as per architectural drawings, the corners of the frame being fabricated to the true right angles. Both the fixed frames and openable shutter frames shall be fabricated out of sections cut to required length, mitered and mechanically jointed for satisfactory performance. All members shall be accurately machine milled and fitted to form hairline joints. The jointing accessories such as aluminum cleats, stainless steel screws etc. shall not to cause any bi-metallic reaction by providing separators, wherever required. Vertical members of the aluminum frame work shall be embedded in the floors, wherever required, by cutting and making good of the floor.

(o) FIXING OF ALUMINIUM FRAME WORK

- i. The screws used for fixing fixed aluminum frames of the aluminum windows to masonry walls / RCC members and aluminum members to other aluminum members shall be of stainless steel of approved make and quality and of stainless steel grade 304. Threads of machine screws used shall conform to requirement of I.S. 4218.
- ii. The weather silicone sealant shall be of such approved colour and composition that it would not stain or streak the masonry / R.C.C. work. It should not sag or flow and shall not set hard or dry out under any conditions of weather and shall be tooled properly. The weather silicone sealant shall be used as per the manufacturer's specifications and shall be of approved colour and shade. Any excess sealant shall be removed / cleared.
- iii. Fixing of glass panes shall be designed in such a way that replacing damaged / broken glass panes is easily possible without having to remove or damage any members or interior finishing materials.

(p) PROTECTIONS AND CLEANING

- a) All glass panes shall be retained within aluminium framing by use of exterior grade microwave cured EPDM gaskets. Use of glazing or caulking compounds around the perimeter of glass will not be permitted. There shall be no whistling or rattling. Before installation of glass, Contractor shall ensure the following:
 - All glazing rebates shall be square, to plumb, true to plane, dry and free from dust.
 - Glass edge shall be clean and cut to exact size and grounded
- b) Glass of specified thickness in doors, windows, ventilators and fixed glazing etc. shall be of approved make and standard quality conforming to C.P.W.D. Specifications

(q) GUARANTEE FOR ALUMINUM WORK

- i. The contractor shall guarantee about proper design and performance of aluminium work for a period of 10 years from the date of completion of work.
- ii. The design and installation shall be to the best international standards and shall specially take account of wind and seismic loads, storms, thermal stresses, building movements and the like.
- iii. The 10 year guarantee, shall be furnished in non-judicial stamp paper of value Rs.100/- or more, in prescribed Performa for performance of glazed units, anodizing, EPDM/silicon gaskets and sealants. The guarantees shall be submitted before final payment and shall not in any way limit any other rights to correct which the Engineer-in-charge may have under the Contract.

10.0 FLOORING, MARBLE, CLADDING WORK:

All flooring work and cladding work in Granite, Tile, Marble, Stones, Laminated, PVC Vinyl etc. in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with revisions/ amendments / correction slips upto last date of bid submission (including extensions if any). The tiles / stones shall be as specified in the schedule of finishes and architectural drawings provided with tender document. The tiles / stones shall be of approved colours and shades and will be laid in

pattern as per approved architectural drawings or shop drawings. Nothing extra shall be paid for laying tiles / different stones in specific design/pattern. The tiles shall be of first quality of approved make and nothing extra shall be paid for use of cut/sawn tiles in the work. Schedule of finishes mentioned in tender documents shall be followed in case of deviation/different detailing is shown in Architectural Drawings. Before taking up any procurement/construction activity, shop drawings shall be prepared and submitted for obtaining approval from Engineer-in-Charge.

- 10.1 Proper gradient shall be given to flooring for toilets, verandah, kitchen, courtyard, corridors etc. so that the wash water flows towards the direction of floor trap. Any reverse slop if found, these shall be made good by the contractor by ripping open the floor/grading concrete and nothing shall be paid for such rectifications.
- 10.2 Samples of flooring material are to be deposited well in advance to the Engineer-in-Charge for approval. Approved samples should be kept at site with the Engineer-in-Charge and the same shall not be removed except with the written permission of Engineer-in-Charge.
- 10.3 The samples shall be submitted along with the following details:
 - a) Three representative samples for each type of flooring/cladding specified.
 - b) Details of physical characteristics such as dimensional tolerances (within the specified limits), water absorption, compressive strength, Mohs Hardness, Specific gravity with reference to IS or International standards.
 - c) Source of supply and confirmation of availability in full quantity and uniformity of colour, tone and textures.
 - d) Company profile of Suppliers.
- 10.4 The Engineer-in-Charge or his representative may, if required, visit the source of supply of the various materials (Granite / Stones / Marble / Tiles / Cladding etc.) to assess the quality as well as availability of the material in the required quantities.
- 10.5 The entire supply for each type of granite/stone slabs shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc. to keep variation(s) in stones used at any one floor to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the Engineer-in-Charge, shall not be used in the work and shall be removed and replaced by the Contractor. Also, no claim of any kind shall be entertained from the Contractor on this account.
- 10.6 Based on the samples approved by the Engineer-in-Charge for various flooring and dado / cladding materials as specified hereinafter, the contractor shall prepare mock up(s) at site of work for approval of quality of workmanship and material specified. If the quality of the workmanship and the material is as per the required standards and approved by the Engineer-in-Charge, the mock up shall be allowed as part of the work. Otherwise, it shall be dismantled by the contractor as directed by the Engineer-in-Charge and taken away from the site of the work at his own cost. The mock up(s) so made shall be kept till completion of respective works for reference.
- 10.7 The (Granite / Stones / Marble / Tiles / Cladding etc.) shall be transported to site well packed in boxes or otherwise. These shall be handled carefully to prevent any damage. Granite stone slabs shall be individually packed in cardboard paper. The various types of stones and tiles, procured shall be free of any surface defect or any edge damage. The damaged (Stones / Marble / Tiles / Cladding etc.) shall not be allowed to be used in the work. So, the contractor shall procure additional quantity of the stone and tiles to cover such contingencies. The stone slabs shall not be waxed or touched up with dyes / colours
- 10.8 The following tolerances shall be allowed in the dimension of granite stone slab:

- a) Length \pm 1mm
- b) Width \pm 1mm
- c) Thickness - 1mm
- d) Angularity at corners \pm 0.25%

The stone (slab and tiles) not meeting the above tolerance limits shall be rejected and not permitted to be used in the work.

- 10.9 Stones slabs shall have uniform thicknesses within the tolerance limits and linear items like treads, sills and jambs, coping, risers, urinal partitions, kitchen / wash basin platforms, vanity counters, facias and other similar locations etc. shall have edge polished calibrated thickness i.e. exposed edges shall have edge polished uniform thickness throughout the length of the work.
- 10.10 The flooring work shall be carried out as per the architectural drawings in design and pattern (geometric, abstract etc.) and in linear and / or curvilinear portions and in combination with stones of different colour and shade and ceramic tiles etc. For the flooring portions curved in plan, the stone slabs (at the edge) shall be cut to the required profile and shape as per the architectural drawings. Nothing extra shall be payable on this account and any consequent wastages and incidental charges on such accounts shall be deemed to be included in the cost.
- 10.11 The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the Engineer-in-Charge. Wherever stone slab other than in single piece is allowed to be fixed, the joints shall be provided as per the architectural drawings and as per the directions of the Engineer-in-Charge. In the cabin areas, the joints in sills shall preferably be provided in line with the partition wall. Depending on the number of joints, as far as possible, the stone slabs shall be procured and fixed in slabs of equal lengths as per the architectural drawings and as directed by Engineer-in-Charge.
- 10.12 The specifications for dressing, laying, curing, finishing etc. for the granite stone flooring shall be same as that of works for the Marble flooring, skirting and risers of steps under Flooring Sub Head of the CPWD Specifications. The wall lining / veneer work with granite stone shall be as per the CPWD Specifications for Marble work Sub Head.
- 10.13 Wet stone/granite wall cladding (in interior) shall be fixed in average 20 mm thick cement mortar in 1:3 (1 cement: 3 coarse sand), with copper pins 7.5 cm long, 6 mm diameter for securing adjacent stones in stone wall lining.
- 10.14 For flooring work, the joints between the different types of flooring shall be located as per the architectural drawings. Also, the Contractor shall maintain the uniform level of the finished flooring of the different types unless specifically mentioned on the architectural drawings.
- 10.15 All the flooring works specified under this sub-head shall be adequately protected by a layer of plaster of paris which shall be laid over a 400 micron PVC film. The protective layer shall be maintained throughout the execution of works and removed just before handing over of the site.
- 10.16 One piece Granite stone for treads / risers in staircase shall be used including rounding of nose.
- 10.17 POP protection layer shall be laid on all finished floors for protection from damage during execution of other items of work in that area which shall be removed and cleaned just before handing over of the premises.
- 10.18 For the skirting in the enclosures with curvilinear profiles, the (Stones / Marble / Tiles / Cladding etc.) shall be cut to the required size and the shape to match the profile and/ or the joints as per the architectural drawings. Similarly, the skirting shall be fixed in a manner as to flush or project from the finished face of the wall as per the architectural drawings and as directed by the Engineer - in-Charge. Any chasing of the masonry works required for such fixing is deemed to be included in the cost of masonry.
- 10.19 Granite stone tiles and slabs shall be pre polished (mirror polished), eggshell polished, flame finished or given any other surface treatment as specified in finishing schedule or architectural drawings and as directed by the Engineer-in-Charge.

- 10.20 Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the Engineer-in-Charge may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of tiles / slabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after installation, shall be rejected and shall be replaced by the Contractor at his own cost.
- 10.21 The exposed cut edges of the Kota Stone slab in risers and treads along its width (sides of the risers and treads of the steps i.e. along the shorter dimensions of the Kota stone slab for the risers and treads) shall be polished in a workmanlike manner. The top exposed edge of the Kota stone skirting shall also be polished in a workmanlike manner.
- 10.22 Nosing / edge moulding shall be provided to the front edge of the Kota stone slab treads along its length i.e. along the longer dimensions of the Kota stone slab, as per the architectural drawings.
- 10.23 At the time of handing over, flooring & dado / cladding shall be free of any scratches, stains etc. The flooring & dado / cladding shall be properly cleaned before handing over. However, abrasive cleaners shall not be used to clean the marks and other scratches.

11.0 ROOFING WORK:

All roofing work in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with revisions/ amendments / correction slips upto last date of bid submission (including extensions if any). Schedule of finishes mentioned in tender documents shall be followed in case of deviation/different detailing is shown in Drawings. Before taking up any procurement/construction activity, shop drawings shall be prepared and submitted for obtaining approval from Engineer-in-Charge.

- 11.1 Khurras shall be of 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1mx1mx400micron, finished with 12mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges.
- 11.2 At inlet mouth of rain water pipe, cast iron grating 15 cm diameter and weighing not less than 440 grams shall be provided.
- 11.3 Rain Water Pipes - All the RWP pipes shall be PVC Pipes (including with required fittings and clamps) exposed on walls / in the shafts to be executed as per CPWD specification 2019.

12.0 FINISHING WORK:

- 12.1 No plastering to be done at Ceiling where false ceiling is proposed.
- 12.2 All junctions of concrete and masonry work and other locations shall be provided with approved galvanized chicken wire mesh (24 gauge 12 mm sizes) fixing in position with galvanized wire nails as per specifications or providing grooves of required size at the junctions, all complete as per directed by Engineer-in-charge.
- 12.3 Necessary drip course shall be provided in Chajja, Balcony, Projecting Roof, Beams etc.
- 12.4 All the internal surfaces including exposed ceiling (non false ceiling areas) shall be finished with 1 mm thick cement based wall putty, one coat of cement primer and two or more coats of paints specified in finishing schedule.
- 12.5 Application of paints shall be done with mechanical equipment's. Mechanical sanding machine (for scrubbing & preparation of surface) shall be used by the contractor.

12.6 In case of painting work, the contractor shall give proper notice to the Engineer-in-charge after the surface is prepared & before applying of primer coat / paint. The Engineer-in-charge shall either approve the surface thus prepared or ask the contractor to rectify the defects pointed. Only after approval by Engineer-in-charge, the priming / painting coat shall be applied.

13.0 STAINLESS STEEL WORK:

Unless otherwise specified, stainless steel generally shall be of Grade (SS 304) or (SS 316). Stainless Steel (SS) grade 316 shall be used for exposed / exterior work whereas grade SS 304 shall be used for interior works. Lower grades shall not be used. Before taking up any Procurement / construction activity, shop drawings shall be prepared and submitted for obtaining approval from Engineer-in-Charge.

Surface finish of all the stainless steel materials will be in 240 grit satin finish / matt finish. All stainless steel material will have to be coated by a solution of Inox to avoid finger in prints and avoidance of settlement of environment / atmospheric dust. Fixing shall be done by stainless steel expansion bolts of approved size and make as per Engineer-in- Charge and welding to be done by using organ welding rods and the surface being duly finished and cleaned by K2 passivation, which is nitric acid plus fluoric acid solution treatment by which the chances of corrosion will be eliminated and any burn out makes on the metal will also be eliminated.

14.0 DELETED

15.0 DELETED

15.1 Name Boards for buildings shall be of approved design and make (like suitable gauge, 2 feet height SS 304 lettering) with LED backlit.

Each signboard to be fixed strictly as per the Harmonised Guidelines & Space Standards for Barrier Free Built Environment for persons with Disability, issued By MOUD, Govt. of India, and as per approved drawings and complete as per the directions of Engineer - In - Charge. Size of the Signboards shall be proportional to the layout plan of the particular building.

16.0 Façade Work :

This specification covers the general requirements of external facade work (e.g. Structural Glazing, Curtain Wall, Sintered tile cladding, ACP, Aluminium composite/Puff/sandwich Panels, etc.) including engineering design involving structural stability of system as a whole e.g. supply, fabrication, installation, testing, ensuring water tightness and maintenance etc. Work under this section shall be performed by specialized agency, who is regularly engaged in the engineering, fabrication, finishing and installation of façade work including glazing and sealing of glass etc. and having experience in similar works. The contractor shall submit-full details and credentials of specialized agency for verification and to demonstrate to the satisfaction of the Engineer-in-charge that he has successfully completed similar works over as per the CPWD guidelines. Only after written approval of engineer in charge, the contractor will engage such specialized agency for this work.

16.1 SCOPE OF WORK:

16.1.1 The scope of work includes all labour, material, equipment and services as required for the complete design, engineering, testing, and fabrication, assembly, delivery, anchorage, installation and water tightness of the façade system. The façade system includes Sintered porcelain tile cladding with vapor barriers, Unitised / Semi-unitised structural glazing, curtain wall, curtain glazing, skylight, aluminum louvers, Aluminum composite / Puff / sandwich Panels, etc. Anchorage includes all primary and secondary anchor assemblies and supportive structural framing as required for securing the facade to the building structure.

- 16.1.2 The contract documents define only the design intent and general performance requirements. The contractor is fully responsible for design, structural calculations, shop drawings, procurement of materials, fabrication, installation, warranties, certifications and related documentation. The entire work shall be carried out strictly in accordance with the true intent and meaning of the specification and drawings taken together regardless of whether the same may or may not be shown particularly on the drawings or described in the specification provided that the same can be reasonably inferred.
- 16.1.3 Only suggestive sizes and details are proposed by the Engineer-in-charge that has a visual impact on facade. Contractor's fabrication / shop drawing will seek these suggestions and design the final construction details. The complete design of façade system will be submitted by contractor to engineer- in-charge for approval.
- 16.1.4 The facade shall be designed, fabricated at works, supplied, delivered and installed in accordance with the shop drawings and samples of materials approved by the Engineer-in- charge and shall be constructed to meet the performance requirements and standards.
- 16.1.5 In general, the façade system should be designed to suit the aesthetics and performance requirements, taking into consideration the necessary factors to suit fabrication and the site conditions for erection.
- 16.1.6 The contractor shall strictly follow, at all stages of work, the stipulations contained in the Indian standard safety code and the provisions of the safety rules for ensuring safety of men and material. The successful bidder shall submit a safety plan for approval of the Employer. On approval of the same, the same shall be followed during the currency of the contract.
- 16.1.7 The contractor must comply with all applicable local-building regulations and all the safety guidelines particularly specified for facade work as per relevant I.S codes.
- 16.1.8 Shop and field materials and workmanship shall be subject to inspection of the Engineer-in- charge and his authorized representative at all time. Such inspections do not relieve the contractor from obligations to provide materials conforming to all requirements of the contract documents and industry standards for material quality.
- 16.1.9 All approvals, instructions, permission, checking, review etc. whatsoever by the Engineer-in- charge shall not relieve the contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship etc. of the facade system.
- 16.1.10 Testing will be done as per nomenclature of the item of typical DGU Panel of approved size in factory and in field through an approved testing agency.

16.2 Façade System Description

- 16.2.1 The contractor shall provide a suitable framing system for vertical façade application keeping in view the performance characteristics and aesthetics requirements.
- 16.2.2 The vertical structural glazing system shall be fully unitized / Toggle based curtain wall (refer chart for various location-types) and shall be designed to suit sealed insulated glass units (hereafter referred to as "IG unit"). Aesthetically the design of the glazing system shall provide a filtering

envelope to the building and provide a uniform appearance. The glazing system shall have flush glazed exterior joints both horizontal and vertical. The structural glazing system shall be designed to receive fixed glazing as well as structurally glazed openable vents with protection of the glass edges. The contractor shall take adequate measures to ensure the thermal performance of the glazing system under the increased solar radiation prevalent in the region. No onsite sealant application will be permitted except for weather sealant in case of unitized system. The system shall comprise of factory prefabricated glazed vision and spandrel panels. The system should preferably permit re-glazing of vision panels from outside the building. The contractor should choose an approved system also keeping in view the various requirements arising during future maintenance during the life span of the glazing system.

- 16.2.3 The structural glazing system is designed to allow for three-dimensional adjustments due to dead load, live load, wind load, seismic load and thermal movement. The framing system is designed to provide adequate support for the IG units to prevent transfer of loads to the glazing below and to provide uniform support to both lites of the IG unit. Intermediate mullions should be of same size as that of outer mullions.
- 16.2.4 The structural aspects of the structural glazing system must be carefully integrated with the glazing rabbet and drainage details to ensure proper performance. The structural glazing system is designed on the rain screen principle with provision for pressure equalization.
- 16.2.5 The structural silicon sealant to be used in this structural glazing system shall be of such quality & designed to transfer wind, seismic, live and dead loads from the glass to the framed structure of the structural glazing.
- 16.2.6 The design incorporate floor-to-floor noise isolators, fire and smoke stops between the floor slabs and sill flashing etc. as per the NBC of India and also of the best international practices.
- 16.2.7 The façade system shall have spandrel panel (over solid surfaces e.g. columns, masonry wall etc.) of Aluminum composite panel (50 mm thick sandwich panel) or toughened glass backed by shadow box (made of Al assembly) as shown in GFC drawings.
- 16.2.8 The façade system consists providing wall insulation with 50 mm thick polystyrene board on all solid surfaces e.g. Spandrel panel area, Aluminum composite panel area etc.

16.3 PERFORMANCE REQUIREMENTS FOR FAÇADE SYSTEM

- (i) Façade System design parameters:
 - a. The façade system and its components are designed to withstand dead loads and live loads caused by positive and negative wind loads acting normal to the plane of the façade system. Design wind loads shall be wind pressure of 190 kg/sq.mtr confirming to IS -875 part III. (The system must pass the proof test at 1.5 times design wind pressure i.e.285 kg/sq.mtr without any failure . The contractor is required to submit the shop drawings and weight of aluminium per meter. The system is designed to withstand seismic forces as calculated in accordance with IS: 1893 (latest revision) under seismic zone V.
- (ii) Deflection:
 - a. The deflection of any structural member in the plane normal to the glass surface when subjected to the specified loads shall not exceed L/175 of its clear span and shall be fully recoverable on withdrawal of the specified loads. Deflection of any framing member shall not exceed 19mm within any glass panel.
 - b. Parallel to façade plane, deflection of a framing member when carrying full design load shall not exceed an amount reducing the glazing unit bite below 75% of the design dimension. It shall also not reduce the edge clearance to less than 3mm nor shall it damage or impair the function of any joint seals.

- c. The deflection of the horizontal member due to the weight of the glass shall be limited to 3mm or 25% of the design edge clearance of the glass or panel below whichever is less.
- d. Twisting or rotation of the horizontal member under dead load of glass shall be limited to 1° by calculation from the horizontal plane.
- e. Deflection limits of Mullion / Transom (Windows or doors for residential purpose) supporting the glass under Wind Load: $L/150$ as per AS 1288:2006
- f. Deflection limits of Transom supporting the glass under dead Load: $L/300$ or 3mm whichever is less
- g. Deflection limits of monolithic glass under Wind Load: $L/60$ or 20mm Max (L = Shorter span) – (For the purpose of glass selection, design wind pressure is assumed to be of duration 3 second wind gust.), whichever is less
- h. Deflection limits of Insulated glass unit under Wind Load: $L/90$ or 20mm Max (L = Shorter span) -(For the purpose of glass selection, design wind pressure is assumed to be of duration 3 second wind gust.)
- i. Deflection limits of Aluminum Sheet at center of panel $-L/60$ or 20mmmax.(L is Shorter Span)
- j. Deflection limit (Aluminum Louvers) of the Structural frames and stiffening rib members $-\text{span}/175$

(iii) System assembly:

The system assembly should accommodate the following without damage to the system, components or deterioration of seals.

- Movement within the system
- Movement between system and perimeter framing components.
- Dynamic loading and release of loads
- Deflection of structural support framing
- Tolerance of supporting components
- Shortening of building concrete structural columns
- Creep of concrete structural members
- Inter story drift
- A mid span slab edge deflection: of 25mm
- Accommodate building construction tolerance of +30mm. These tolerances are not cumulative.

(iv) Water Tightness:

Water penetration shall be defined as the appearance of uncontrolled water on inside face of any part of the structural glazing. No water leakage will be permitted when tested in accordance with ASTM E331. The test shall be carried out for duration of 15 minutes with a test pressure difference of 20% of design pressure with a minimum differential of 137 N / mm² and a maximum of 575 N / mm². The minimum uniform water flow rate of 3.4L/m²/min.

16.4 LABORATORY TESTS FOR WATER INFILTRATION:

(i) Tests:

- a) TESTS FOR WATER INFILTRATION: Static Pressure Test: No water infiltration shall occur when the mock-up is tested accordance with ASTM E-331 with the static pressure differential and the total time as specified.

b) Dynamic Pressure Test: No water infiltration shall occur when the mock-up is tested in accordance with AAMA 501.1 with the dynamic pressure differential and the total time as specified.

(ii) FIELD MOCK – UP:

In the presence of representatives of Owner, Engineer-in-charge, Contractor, Installer and Manufacturers, the Testing Agency shall conduct field tests on each of the installed Mock-Ups in accordance with methods described in AAMA 501.2 "Filed Check of Metal Curtain Walls for Water Leakage" using the loads specified in "performance Criteria". Notice for testing to allow for witnessing test shall be given several weeks before. Approximately 50% of each Field Mock-Up shall be field water tested. All interior finishes including trims should be left off to allow for clear viewing.

(iii) REMEDIAL WORK:

If the Field test of any Mock-Up reveals leakage, points of entry and paths of flow of water shall be identified, analyzed, and necessary remedial work shall be established, subject to Engineer-in-charge's Employer's review and comment. Repairs and/or modifications shall be made to the entire mock-up based on these findings and, after adequate curing of all sealants, re-test to successful conclusion. Re-testing after remedial work shall be from 50 percent to 80 percent of the mock-up at the Engineer-in-charge's recommendation. The re-test area designated does not necessarily have to be exactly the same as the original test area of the mock-up.

16.5 METHOD STATEMENT FOR HOSE TESTING (ON SHORE) AT SITE:-

- (i) STANDARD: - AAMA 501.2 — 94 Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage.
- (ii) TEST AREA: - Area (s) to be tested will be selected by the Engineer-in-charge accordance with the standard. The total area will be not more than that can be tested in one day. Testing shall be done at least one area of 100 square feet, in accordance with the test standard, or more, depending on the time, and availability of suitable access to the exterior. In case of failure the prescribed procedure for a reasonable time but not more than that can be completed on the same day shall be followed. The test will be supervised via two-way radio from the inside.
- (iii) EQUIPMENT:- Testing equipment's generally consists of the following and any other equipment's as required for carrying out the test
 - The 'Monarch' nozzle with pressure gauge and valve as prescribed by AAMA and recommended by CWCT.
 - Two-way headset radio for communication between engineers and the people in the cradle.
- (iv) Other Requirements:
 - a. Visual checking of test area for snags, visible defects etc.
 - b. A cradle or scaffolding on the exterior at the locations (s) of the test specimen (s) with an operator, a person to stabilize the cradle, a person to hold and point the nozzle, technical person to communicate between the people on the exterior and test engineer.
 - c. Clean water in a minimum'/. " supply hose with approximately 4 bar pressure. Note that the pressure given for the test is with the water flowing, much higher actual pressure is necessary. Water pressure drops 1 bar for every 10m rise in height.
 - d. Drying of test area and application and removal of tape if necessary to locate leaks.

(v) TEST CRITERIA:-

Water will be sprayed at a pressure of 30 –35 psi (2.07-2.41 Bar) in accordance with the test standard. The flow rate will not be monitored. The nozzle will be held 30 cm. from the wall spraying 1.5m lengths back and forth along each joint, successively, for five minutes each, working from the bottom up. Joints are interfaces between materials, and where these are less than 120mm apart are to be considered one joint.

(vi) TEST PROCEDURE

- a) The initial area shall be the width of the cradle. The lowest horizontal joint will be wetted first, covering each 1.5m length in five minutes.
- b) Next the cradle will be positioned so that the first 1.5m above the bottom horizontal joint can be reached and each vertical will be sprayed in turn over a period of 5 minutes.
- c) The cradle will then be raised to test the next 1.5m and then the next horizontal and so on.

(vii) LEAKAGE:

If there is any leakage the test will be stopped and the procedure described in the Standard will be followed up to the time allowed. A compliance report suggesting any modification / corrective steps to be taken if any leakage was observed.

- 16.6 Air Infiltration: When tested in accordance with ASTM E283, air infiltration shall not exceed 0.03 l/s/sqm. Of wall area, measured at a reference differential pressure across assembly of 200 Pa.
- 16.7 System internal drainage: Drain water entering joints, condensation occurring in glazing channels, or route moisture occurring within the system to the exterior by a weep drainage network. Drained joint pressure equalised system which shall be 100% water-tight allowing no water to penetrate into the interior of the building. The system is designed such that water being drained in the system shall not cause any damage to the permanent works. The system shall not be face sealed and shall not rely on wet seals.
- 16.8 Expansion/Contraction: The system shall provide for expansion and contraction within system components caused by a cyclical temperature range of 80^o Cover a 12hour period without causing any detrimental effect to the system components.
- 16.9 Test for structural performance: When tested in accordance with; ASTM E330, the glazing system shall conform to the performance requirements.
- 16.10 Special instructions: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of the system will not be permitted.
- 16.11 Heat soaking of glass: To minimize nickel sulphide (NIS) fractures at site, heat soaking test is to be conducted within the factory. Minimizing NiS fractures at site is mainly about making sure that fractures happen within the factory rather than at site after installation. Heat soaking tempered glass is the most-common form of ensuring that the chance of NiS infected panes leaving the factory are minimized. The goal during heat soaking is to induce breakage at the factory to avoid on site breakage after installation. It is heat tempering of glass to 280^o C for 24 to 48 hours over temperature gradients to induce fracture. Due to inherent safety and security benefits it is highly recommended for tempered glass to be heat-soaked.
- 16.12 PRODUCTS/MATERIALS
 - (i) Glass : Standard certification requirements are as under :
 - a) Float glass : ASTM C 1036
 - b) Tempered/ Toughened Glass: Toughened / Tempered glass shall be examined by the glass manufacturer to detect and discard any glass which exceed the following

tolerance: 1.5mm bow in 600mm: 3mm bow in 1500mm; 6mm bow in 3000mm; 9mm bow in 4500mm. Where the strengthening process results in essentially parallel ripples or waves, the deviation from flatness at any peak shall not exceed 0.13mm, and the difference between adjacent peaks shall not exceed 0.13mm. Where bow tolerance and wave tolerance differ, the stricter requirements shall govern. Direction of ripples shall be consistent and in conformance with architectural design. Following test shall be carried out by the glass processor at his own cost as per following provisions and the test report shall be submitted.

Thickness	Impact strength	Fragmentation	Surface Compression	Bending Strength
IS 2835-1987	IS-2553-PART-I	IS-2553-PART-1	ASTM C-1048- 90	DIN 1249-PART:12

- c) Laminated glass: ASTM C 1172. The laminated glass shall comprise of two glass of equal thickness as per design and bonded with a poly vinyl butyral (PVB) interlayer, meeting criteria of ANSI Z97.1 for safety glazing. The PVB interlayer shall be minimum 0.38mm thick. No deviation will be accepted with respect to the PVB interlayer. Laminated Glass Units shall comply to EN12543.
- d) Glazing unit for Insulated Glazed Unit for façade type WT-02, WT-06, WT-04 and WT-05 shall be as: Glass 1-(6mm external glass heat strengthened + 16mm air gap filled with Argon + 6mm clear fully tempered glass internal). Glass performance data for insulated glazed unit shall be :
- o Visible Light transmittance (VLT) of minimum 60%
 - o Light reflection internal - less than or equal to 15%,
 - o Light reflection external - less than or equal to 15 %,
 - o SHGC- less than or equal to 0.57 and
 - o U value - less than or equal to 1.3 W/m² degree K
- e) Glazing unit for façade type WT-08 shall be: 8mm clear fully tempered glass + 1.52mm PVB + 8mm clear fully tempered glass. Glass performance shall be :
- o Visible Light transmittance (VLT) of minimum 65%
 - o Light reflection internal - less than or equal to 23%,
 - o Light reflection external - less than or equal to 23 %,
 - o SHGC- less than or equal to 0.64 and
 - o U value - less than or equal to 5.4 W/m² degree K
- f) Single glazed unit in façade as specified in drawings, shall be 8 mm thick clear heat strengthened glass having following properties:
- o Visible Light transmittance (VLT) of minimum 55%
 - o Light reflection internal - less than or equal to 15%,
 - o Light reflection external - less than or equal to 15 %,
 - o U value - less than or equal to 5.6 W/m² degree K
- g) General Requirements for all types of Glass: All base supply float/coated glass are to comply with the requirement of BS EN 572 parts 1, 2 and 3 or ASTM C1036 and assessed for optical and visual faults as described in BS EN 572-2. Spot faults shall not be no worse than category C. There will be no linear / extended faults. Optical faults shall be within the limits set in BS EN 572-2.
- h) Fully Toughened / Heat Strengthened Glass: It shall comply with the requirements of

EN12150 or ASTM 1048 or EN 1863 -1 for heat treated Soda Lime Silicate Safety Glass. The residual surface compressive stress in the heat strengthened glass shall be below 52N/mm² when measured by GASP in accordance with ASTM F218-95 (2000) or > 69 N/mm² for Fully Toughened glass.

- i) Insulating glazed units: Hermetically sealed insulated glazed unit shall comply with BS5713 or EN 1279. Primary seal shall be of poly-isobutylene located between glass and spacer providing a continuous vapor proof barrier of a minimum width of 2mm and a secondary two-part silicone sealant of approved make extending around the perimeter of the unit. The insulating glass unit shall be certified under a program approved by the sealed insulating glass manufacturer's association (SIGMA) providing third party validation of compliance to ASTM E 773 & E 774. All glass quality shall be glazing as per relevant ASTM standards.
 - j) Coating: Method of coating shall be of vacuum (sputtering) deposition. This coating is applied to control the solar heat gain and enhance the energy performance and comfort level of the building. The coating shall meet the requirements of ASTM C 1376-97 or EN 1096 part 2 and satisfy the thermal performance of the facade.
 - k) To avoid change in glass thickness due to variation in pressure difference from site of manufacturing of glass to the delivery of glass in state of Assam, pressure equalization approach shall be adopted by incorporating metal tube in all DGU panels for adjustment of pressure difference between glass panel and environment atmosphere. At the time of delivery, glass panels cannot have variation of more than 3mm in air gap due to pressure variation for sea level difference of upto 1400 meter (between the site of glass manufacturing and project site). The variation in pressure shall be adjusted with the metal tube by the installer and fixing of required specified glass panels to be completed.
 - l) Performance requirements: Probability of breakage of glass shall not exceed 8/1000 for vertical glass upon first application of design pressures or due to anticipated thermal stresses.
- (ii) Louvers in external cladding: Aluminium Louvers shall be of "Z" / Tube shape spaced at equivalent distance supported on the Aluminium grid work as shown in drawing. Louvers profile shall be fixed in accordance with the manufacture's specifications on back up structure made of structural steel/Extruded Aluminium sections as suggested in drawings. Panel shall be stove enameled and finished with high performance coating, a patented special three layered coating system (consisting of first a conversion layer of thickness 800- 2000mg/sq. mtr, a polyurethane basecoat of 16-20 microns, and a special top coat of polyamide particles of 8-12 microns thick to provide excellent abrasion and damage resistance) in a continuous coil coating process of the approved colour on the exposed side and the reverse side with epoxy. The sizes of all the fixing assembly shall be worked out by contractor by designing for performance criteria (wind load, snow load, seismic load, deflection, strength etc.) mentioned in this document or prescribed by various standard/codes. The brackets shall have provision for movement to accommodate the movements due to seismic, thermal expansion, composite construction tolerances. The purpose and intent of the louvers is to be functional with HVAC requirements. Hence the sealing of perimeter between the louvers and the carrying façade (part of façade above and below) should be air-tight. Panels will have movable louvers, and fixed louvers. The Contractor shall provide a data to confirm compliance with specific requirements for resistance and fire properties. The guarantee should be for a 20 year period against peeling and fading.
- (iii) Perforated Metal Screens: It consists screen panel various sizes as per requirement and as per architectural drawings, manufactured from high corrosion resistant Aluminium Alloy of 2 mm thickness which shall be fixed to rigid and suitable substructures as per manufacturer's recommendations. The panel shall be coated on visible side with exterior Architectural highly durable "Qualicoat" coating in approved color, properties meeting as per AAMA 2603 and ROHS with minimum fifteen years warranty. The panels shall be bend with the help of NC bending technology with six roller levelling process which ensures flatness of panels from all four sides and shall have extended flanges to accommodate clamps. There would be provision of expansion joint of 20 mm between two adjacent panels ends. The entire installation shall be

carried out as per manufacturer's recommendations.

- (iv) EXTERNAL BRICK / AAC MASONRY WALL - All the exterior masonry walls (e.g. behind tiles / sandwich panel, at spandrel panel, behind textured paint etc.) shall be provided with cement mortar plaster mixed with waterproofing compound as per manufacturer's specifications and RCC / masonry wall joints to be provided with mesh.
- (v) Openable panel (IGU), side hung or top hung, shall be provided as mentioned in drawings or as per extant guidelines of NBC, Indian standards and local bodies. These panels shall be installed with all accessories and hardware's for the openable panels as specified/required and of approved make such as heavy duty stainless steel friction hinges, minimum 4 point cremone locking sets with stainless steel plates, handles, buffers etc. including necessary stainless steel screw, nuts, fasteners, bolts, washers etc. The sheet shall be made of 0.45 BMT with AZ150 coating with coating mass of 150g/m². The roofing sheet material shall accommodate the building movements, thermal expansion and seismic movements. Also, shall accommodate thermal expansion resulting from surface temperature of 80-90 degree Celsius on roofing system without creating any additional stress. The panels shall be fixed in accordance with manufacture's recommendations to back up structure made of structural steel/Extruded Aluminium sections as suggested in drawings. The sizes of all the fixing assembly shall be worked out by contractor by designing for performance criteria (wind load, snow load, seismic load, deflection, strength etc.) mentioned in this document or prescribed by various standard/codes. The Contractor shall provide a data to confirm compliance with specific requirements for resistance and fire properties. The guarantee should be for a 20 year period against peeling, fading, blistering, flaking, chipping and fire properties.
- (vi) Sealant:
- a) The insulated glass unit shall have poly-Iso-butylene as primary sealant with low moisture vapour transmission rate and a structural silicone sealant for secondary seal. The secondary edge sealant shall conform to ASTM C 1369-97. The contractor shall indicate the classification of the edge sealant as per clause 5.0 of the ASTM C 1369. Structural flush glazed joints shall be a neutral cure high performance silicone sealant applied in accordance with the sealant manufacturer's instructions. Weather seal joints shall be a neutral cure medium modulus silicone sealant applied in accordance with the sealant manufacturer's instructions. Sealants shall be black color. Unexposed, low movement flashing joints shall be non-drying, non-skimming, non-oxidizing, non-bleeding glazing sealant meeting MMA 809.2. The sealant proposed by the contractor shall not bleed or stain under any circumstances. Contractor shall identify the sealant to be used along with the structural glazing system and submit detailed technical parameters of the sealant by way of the sealant manufacturer's printed data sheets. The Contractor will be responsible to carry out all the compatibility tests as listed below but not restricted to the following, with respect to the particular sealant from a laboratory approved by the engineer-in-charge. The following tests shall be carried out with respect to the sealant:
- ASTM C 794 Peel test
 - ASTM C1135 -Test method for determining Tensile-Adhesion Properties of elastomeric sealant
 - ASTM C-719 -Test method for adhesion and cohesion of elastomeric joint sealant under cyclic movement
 - ASTM C-1087 -Compatibility test between the proposed structural silicone sealant and the finished aluminium extrusions (mullions and transom)
- b) For all sealant proposed to be used for this project, the contractor shall submit a letter of certification from the sealant manufacturer stating that the sealant has been tested for adhesion and compatibility on production of samples of metals, glass and other glazing components and that all sealant details and application procedures shown on the shop drawings are acceptable for use.
- c) To prevent excessive shelf life and facilitate the correlation of batches of sealant with panel production, silicone sealant generally shall be used in the sequence of their manufacture.
- d) The structural glazing contractor shall obtain from the manufacturer and the supplier written

confirmation of that the material has not been subjected to temperatures in excess of 27 degree centigrade between manufacture and delivery to the contractor's factory. The contractor shall store all silicone sealant at or below 27 degree centigrade up to the day of its application.

- e) Silicones which cure by different chemical reactions or which release different chemical by-products, e.g. acetic acid, alcohols, amines etc. during cure, should not come in contact to each other during fabrication, assembly and erection of the glazing system.
- f) All adjoining surfaces not to receive sealants shall be protected against staining by masking tape.

(vii) Other materials:

- a) The aluminium extrusions shall be 6063 alloy T6 temper conforming to ASTM 8221 or equivalent. They shall be clean, straight, with sharply defined edges and free from distortion and defects impairing appearance, strength and durability. It shall be of suitable wall thickness and profile for strength with respect to tension, shear and bending stresses, and lateral stability.
- b) Fixing bolts, screws and nuts, where in contact with aluminium, will be of stainless steel 304 grade. Glazing tape for structural glazing shall be Norton or approved equivalent.
- c) All dissimilar metal surfaces shall be isolated to prevent anti galvanic action. Materials used for this purpose shall be non-absorptive. Metal surfaces shall be separated in such a manner that metal does not move on metal.
- d) Aluminium surface in contact with mortar, concrete fireproofing, plaster, masonry and absorptive materials shall be coated with anti-galvanic moisture-barrier material and nothing extra will be paid for this.

(viii) Accessories:

- a) Extruded gaskets, weather stripping, extruded seals and spacers which do not come into contact with structural silicone sealant shall be of ethylene propylene diene monomer (EPDM). Where in parallel contact with structural silicone sealant, all gaskets, setting blocks and spacers other than foam glazing tapes shall be of heat-cured silicone rubber, chemically compatible with the silicone sealant and suitable for the specific purpose intended. All extruded gaskets, weather stripping and spacers other than foam glazing tapes shall have continuous mechanical engagement to framing members; any adhesive attachment is not acceptable. Unless otherwise approved, gaskets, weather stripping, extruded seals and spacers shall have a hardness of 40+5 durometer Shore A.
- b) The cladding system shall be constructed with (and shall maintain during Its design life) a standard of seal which shall not result in any reduction of sound insulation performance. Gaskets, weather stripping and seals used to achieve the required weatherproofing and/or air tightness shall be selected to accommodate fully the range of dimensional tolerances associated with fabrication and installation of the cladding system. Gaskets, weather stripping and seals shall be formed from materials capable of retaining their elastic qualities, dimensions and resistance to physical and chemical attack sufficient to maintain the full water tightness, air tightness and acoustic performance for the design life of the structural glazing system.
- c) Extruded gaskets, weather stripping, seals and spacers mechanically engaged by flutes or pockets extruded in framing member shall be installed without residual tension or extension. Dry lubricants may be used to reduce drag during installation of synthetic rubber extrusions and to induce compression so as to prevent gradual elastic shrinkage and retraction from their ends. Wet lubricants containing detergent shall not be used in any location from which spillage onto glass and aluminum surfaces cannot be immediately and completely removed at the factory. Concentrated detergents shall not be used for any purpose which may bring the liquid into contact with the coated surfaces of vision and spandrel glass.
- d) Setting blocks shall be dense heat-cured silicone rubber with a hardness of 80 to 90

durometer Shore A. Side blocks and anti-walking blocks shall be dense heat-cured silicone rubber with a hardness of 60 to 70 durometer Shore A.

- (ix) Flashing: To prevent leakage, flashing shall be formed from either stainless steel or aluminum or sheer neoprene of 1.5mm thickness with joints tapped and sealed 150mm minimum. Flashing shall be provided on all sides of glazing where external glazing terminates and wherever else required to provide a completely watertight installation. Wherever visible, it shall have the matching finish of Aluminum.
- (x) Column closers: The Contractor shall supply and install suitable closer section to seal up the gap between columns and / or walls, which abuts the line of the external glazing. The principal function of the closer piece shall be to provide a neat connection with the external glazing as well as a means of cutting off stray artificial light from the outer face of the column / wall. The column closer shall be installed in such a way as to provide a flexible connection to allow for tolerances, building I external glazing movements and dimensional differences between the external glazing and the column and / or wall face. The column closer shall also be designed in such a way as to allow the following:
- Easy removal for maintenance.
 - Installation after finishes are applied to the column / wall.
 - Easy removal of internal glazing units for cleaning/ maintenance replacement.
 - Compatibility with the requirements of the fire safety requirements.
- (xi) Fire Stop : At each floor edge, the required fire protection is to be maintained between elements of structure by using fire stop insulation to give a minimum of 2 hours fire protection between floors including in front of columns or blank walls. The fire stop material is to be installed to completely seal up the void between the face of the structure and the glazing and shall fully comply with local Codes and Regulations. The fire stop material must be flexible to allow movement between the structure and the external glazing. The fire stop material shall be located and held In position in such a way so as to ensure integrity of the fire protection as well as preventing accidental damage or loss of materials. The Contractor is required to provide full details of all fire stop material including fire test certificates and confirmation of local Fire Service Bureau approved material status. Shop drawings shall also be submitted for approval showing the full details of fire stops.
- (xii) Finishes: All exposed framing members shall be free of scratches and other blemishes. All aluminum surfaces shall be electrostatic powder coated in stainless steel colour or as approved by the Engineer-in-charge. The anodic coating shall conform to IS:1868 - 1968 / IS- 5523:1983 and shall be of AC25 grade with minimum thickness of 20 microns when measured as per IS: 660/2-1970 and density shall be at least 32 Mg/sqm. The anodic coating shall be tested in an approved laboratory by eddy current method as per IS:6012 for thickness. Sulphuric acid shall be used as the electrolyte for the anodic process. Prior to anodizing, all aluminium shall be rendered uniform in appearance free from disfiguring scratches, stains or other blemishes and etched in caustic soda solution. Requisite tests shall also be carried out at the site as required by the Employer and the contractor shall arrange all assistance and equipment required for the purpose.

- 16.13 PROGRAMME OF WORK: The contractor shall submit a detailed program of work along with time schedule indicating the various items of work pertaining to the structural glazing work as below-
- Design and approval
 - Shop drawings
 - Submission of samples
 - Mock-up
 - Test reports
 - Material co-ordination, ordering and delivery
 - Fabrication
 - Installation
 - Inspection and remedial measures.

16.14 DESIGN CALCULATIONS:

- a. The contractor shall be responsible' for the design of the facade system including all its various components like glass, sealant, framing system, gaskets, fixing and anchorages proposed by respective specialists. The contractor shall submit structural design calculations prepared in accordance with relevant Indian/International codes and standards as applicable. The design shall be carried out under the direct supervision of a professional engineer experienced in design of this type of work and licensed at the place where the project is located. Structural design shall include, but not limited to, computations for the justification of external facade sections and connections including fasteners, welds and anchorage assemblies.
- b. The contractor shall submit for Engineer-in-charge's approval all structural calculations with reference to structural properties and physical characteristics and dimensional limitations of the framing members of the facade system. The contractor shall also submit design calculations for all connections, die dimensions of all extrusions and complete data to be used for the project. Approval of structural calculations shall not relieve the contractor from any of the responsibilities and requirements specified therein.
- c. The contractor shall submit the, glass manufacturer's wind pressure analysis, seismic load analysis and thermal analysis showing that the 'specified maximum deflections and probabilities of breakage are not exceeded.

16.15 SHOP DRAWINGS

- a. The contractor shall prepare and submit shop drawings in case of any discrepancy in good for construction drawings and actual requirement, showing clearly the relationship of the structural glazing facade to the building structure, Mechanical and electrical systems, floor slabs and any other related works. They shall show the arrangement of components, instructions and explanatory details for the sequence of fabrication, assembly, erection and installation of all materials including the glass and de-glazing procedures. They shall include the following:
 - i. Plan, elevation and details required to fully describe the structural glazing system.
 - ii. System dimensions framed opening requirements and tolerances for squareness, corner offset and bows.
 - iii. Dimensional position of glass edge/face relative to the aluminium framing, full size junction details between mullion and transom and end details.
 - iv. Isometric drawings of flashing, joints between transom and mullions, end details etc.
 - v. Expansion and contraction joint location and details.
 - vi. Weep and condensation drainage network
 - vii. Full size details including isometric drawing of sealing, flashing and jointing Methods
 - viii. Materials, type, size, location, spacing of all screws, bolts, weld; anchoring devices and all accessories.
 - ix. Die drawings for, all gaskets, extrusions
 - x. Relationship of edge members with architectural stone/ wall finish and flashing at joints.
- b. The contractor shall submit a fully detailed program for the presentation of shop drawings to the Engineer-in-charge for approval, and in no case shall the contractor proceed with any of these works without approved shop drawings.
- c. The contractor shall review and submit all shop drawings in a sequence consistent with the sequence of erection, installation and assembly of the various elements of the work. He shall be deemed to have determined and verified all materials, site measurements and construction criteria related thereto and to have checked the shop drawings for complete dimensional accuracy.
- d. Any approval by the Engineer-in-charge of the shop drawings shall not relieve the contractor of

his responsibility for any deviation from the requirements of the contract unless he has specifically informed the engineer in writing of such deviation at the time of submission and the Engineer-in-charge has given written approval to the specific deviation.

16.16 SAMPLES

The contractor shall submit all samples at his own cost. Samples shall be submitted for approval well in advance of the date, on which the particular work involving the use of materials for which samples are submitted, is scheduled to begin. The work shall be carried out in accordance with the approved samples. The following shall be submitted:

- 16.16.1 2 samples of 600mm x 600mm in size illustrating pre-coated aluminium mullion and transom junction detail complete with glass skin and glazing materials illustrating edge and corner.
- 16.16.2 4 nos. 12" x 12" samples of each type of glass.
- 16.16.3 4 nos. 6" long samples of principal extrusions.
- 16.16.4 4 nos. manufacturer's samples of each type of aluminium finish.
- 16.16.5 4 nos. manufacturer's samples of each type of sealant
- 16.16.6 2 nos. manufacturer's samples of all accessories and hardware envisaged to be used for the structural glazing system.

16.17 MOCKUP: The contractor shall construct a mockup including intermediate and edge mullion, vision and spandrel panel. The mockup should illustrate component assembly including framing, glass, glazing materials, weep drainage system, attachments, anchors and perimeter sealant. Location for mockup will be at site approved in advance. Mockup will not remain as part of the work.

16.18 TEST REPORTS: The contractor shall arrange for all testing required with regard to this work at his own cost, at such test laboratories in India or abroad as approved by the Engineer-in-charge. Apart from the tests carried out, the contractor shall substantiate engineering data and provide test results of previous tests, which purport to meet performance criteria and any other supportive data.

16.19 SOURCES: The contractor shall submit the name of the suppliers for the following items of work along with the shop drawings and samples.

- a. All components of the structural glazing system
- b. Aluminium extrusions
- c. Anodizing paint from manufacturer I authorized applicator
- d. Sealant
- e. Glass
- f. Hardware
- g. Gaskets
- h. Fasteners
- i. Anchorages

16.20 SUBMITTALS: The contractor shall submit 4(four) copies of the following documents pertaining to the engineering of the structural glazing using structural glazing system to the engineer for approval, review etc.

- a. Shop drawings
- b. Structural design calculations for aluminium framing, glass thickness and sealant by the sizes
- c. Calculations for deflection
- d. Test reports as per the performance requirements
- e. Special installation requirements, special procedures, safety precautions and perimeter conditions requiring special attention as stated by the manufacturer.
- f. Samples
- g. As-built drawings

- 16.21 ORDERING AND DELIVERY: Before commencement of any fabrication or ordering of any materials, goods or works, the contractor shall be required to submit shop drawings, samples etc. with all relevant details as to materials, sizes, manufacturer's printed specifications and all other details and information as desired by the engineer in charge. Mockup shall have to be approved by engineer-in-charge before placing final order for delivery of the approved products.
- 16.22 PRODUCT HANDLING: Handling of glass and aluminium frame, to be incorporated in to the facade system, shall be done with utmost care to avoid any damage or surface scratch. Field cutting of anodized components shall not be permitted.
- 16.23 LIGHTNING PROTECTION: Each complete frame shall be provided with a single bolt, to which the bonding conductor may be connected by the electrical contractor on site. The bolt shall be high tensile, size MB stainless steel, and shall be securely fastened to and in sound electrical connection with the frame. The bolt shall be supplied with two plain washers and locking washers and nuts, by which the bonding conductor will be connected to the bolt.
- 16.24 FABRICATION & INSTALLATION: The façade work shall be fabricated and installed by experienced workmen having specialized skill in façade work/ structural glazing and strictly in accordance with the approved shop drawings. All welding shall be done by the heliarc process and all exposed welds ground to minimum 100 grit finish.
- 16.25 PROTECTION:
- 16.25.1 The contractor shall be responsible for all materials against damage from mechanical abuse and foreign matter during installation. A layer of clear transparent lacquer based methacrylate's or cellulose butyrate shall be applied on anodized members before they are brought to site. The lacquer shall be removed on completion of erection. On virtual completion and receiving instruction from the Engineer-in-charge, the Contractor shall remove all protective coverings, manufacturer's seals, labels etc. The contractor shall thoroughly clear the internal and external glazing area and members with cleaning solution recommended by the respective manufacturers. The Contractor shall ensure that the highest possible standards of material protection are maintained both in the fabrication and installation of the external glazing system. The Contractor shall ensure that all materials and completed panels are delivered to site without damage and that all components are fully protected. In this respect a method statement will be required describing the protection measures to be adopted when transporting material to site and hoisting it into the floors for final installation. Panels awaiting installation are to be stacked on pallets to a height to be stored separately on site for possible fabrication in-situ.
- 16.25.2 All materials stored at site are to be protected in such a manner as to prevent damage from falling objects, dust, water and dirt. The material must be safe from mishandling or damage by any contractor / agency / sub-agency either in the pursuit or their own works or by their personnel.
- 16.25.3 During installation, the Contractor shall provide protection to the external glazing to prevent the ingress of water from either rain or any other reasons. This protection shall be strong enough to withstand adverse wind conditions, and shall provide complete protection at the top level of the installation necessary to prevent the Ingress of water into or behind the cladding.
- 16.25.4 The external glazing shall be screened from weld splatter, spray-on fire proofing, concrete, alkaline masonry washes, paint and other deleterious substances. Any such soiling shall be promptly and completely removed. The design of protective screening shall be such as to provide adequate ventilation of the space between the glass and the protective screen and not induce thermal stresses in the glass. In no case shall the protective screening be placed in contact with the glass.
- 16.25.5 The Contractor shall provide at each completed floor an internal protection of 1000 gauge heavy Polyethylene sheet suspended from the top of the external glazing at slab soffit and extending to the floor. These drop sheets must be maintained until all wet trades are completed on each floor.
- 16.25.6 The fixing method for sheets is to be indicated in shop drawings and a sample approved by the

Engineer-in-charge.

16.26 CLEANING

- a. The Contractor shall ensure that all actions are taken during Installation to eliminate the effects of corrosive substances on the finishes of the external glazing.
- b. The Contractor shall clean both internal and external surfaces to remove corrosive substances. The Internal surfaces of glass and aluminium frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.
- c. The Contractor shall provide written verification that cleaning agents are compatible with aluminium, stainless steel, glass coatings, granite, glazing materials and sealants. In no case shall alkaline or abrasive agent be used to clean the surface. Care shall be taken during cleaning to avoid scratching of the surface by dirt particles.
- d. Prior to snagging inspections, the Contractor shall remove the internal protection sheets and carry out a thorough cleaning of all glass, aluminium and spandrel panels as per the direction of Engineer-in-charge.
- e. The protective sheeting shall then be removed permanently provided that no other wet works or services work are required in the immediate vicinity of the external glazing. The Contractor shall also make good any physical drainage to the wall including scratches, dents, abrasions, pitting's, etc., to the satisfaction of the Engineer-in-charge.
- f. Manufacturer's delivery or job marking on glass and adhesive for manufacturers cables shall be either a neutral or slightly acidic material and in no case shall such material be alkaline. Any staining of glass by alkaline material will be cause to rejection of the glass.
- g. After the installation of each panel of glass all markings and labels shall be carefully and completely removed from the panes. Thereafter no markings or labels of any sort shall be placed on the glass.
- h. Glazed openings shall be identified by suitable warning tapes or flags attached with a non-staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall not be in contact with glass.
- i. Prior to the handing over of each floor to the Engineer-in-charge, the Contractor shall carry out a final cleaning of the external glazing. As soon as it is practically possible after the issuance of the occupation certificate for the building, the Contractor shall carry out a complete cleaning of the external face of the external glazing

16.27 REMOVAL OF IMPROPER WORK AND MATERIALS: Any materials/or works which, in the opinion of the Employer, are not in accordance with the specification, shop drawings and instructions shall be removed from the site immediately.

16.28 PERFORMANCE GUARANTEE: The contractor shall be solely responsible for the design including shop drawings and performance of the installed façade system. The installations shall be guaranteed by the contractor during the guarantee period for materials used, workmanship, water tightness (wherever specified), structural design, performance requirements and other requirements as given in the specifications. The contractor shall submit in the enclosed format a written guarantee for the same for a period of 10 years from the date of completion of the work.

16.29 MAINTENANCE MANUAL: On completion of the works, the contractor shall prepare a detailed maintenance manual for the structural glazing system. The manual should cover the following:

- 16.29.1 Complete and detailed explanation of operating principles of the structural glazing system
Description of all the various components of the glazing system,
- 16.29.2 Recommended Inspection schedule and periodic inspection procedure,
- 16.29.3 Complete parts list,
- 16.29.4 Instructions for proper cleaning procedures and routine maintenance of the facade including frequency,

- 16.29.5 Cleaning products and their source
- 16.29.6
- 16.29.7 Method statement for reglazing and replacement of component parts with appropriate drawings;

SCHEDULE OF ITEMS – STRUCTURE & CIVIL WORKS

	PROJECT NAME:- ESTABLISHMENT OF A CENTRE OF EXCELLENCE IN HEALTHCARE R & D FACILITY
	SCHEDULE OF ITEMS – STRUCTURE & CIVIL WORKS FOR ALL BUILDINGS
ITEM	DESCRIPTION OF ITEM
1	EARTH WORK
1.01	Earthwork in Excavation
	Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth in All kinds of soil including all lifts and leads.
1.02	Earthwork in filling
1.02.1	Excavating, supplying and filling of local earth (including royalty) by mechanical transport, also including ramming and watering of the earth in layers not exceeding 20 cm over pile caps area, existing ground area, in trenches, plinth, sides of foundations etc. complete. Earth compacted to 95% proctor's density.
1.02.2	Filling available excavated earth (excluding rock) over pile caps, in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering. Earth compacted to 95% proctor's density.
1.02.03	Supplying and filling of local Sand (including royalty) by mechanical transport, also including ramming and watering of the sand in layers not exceeding 20 cm over pile caps area, existing ground area, in trenches, plinth, sides of foundations etc. complete. Sand compacted to 95% proctor's density.
1.03	Pre-Constructional Anti-termite treatment
	Supplying Chlorpyriphos / Lindane E.C. 20% and with 1% concentration chemical emulsion Diluting, injecting chemical emulsion for pre-CONSTRUCTIONAL anti-termite treatment of soil as per CPWD specifications.
2	PLAIN CEMENT CONCRETE WORK
2.01	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work in 1:4:8 (1 Cement : 4 coarse sand (zone-III) derived from natural sources : 8 graded stone aggregate 40 mm nominal size derived from natural sources) up to plinth level
2.02	Providing and laying in position ready mixed or site batched design mix cement concrete for plain cement concrete work, using coarse aggregate and fine aggregate derived from natural sources. Portland Pozzolona / Ordinary Portland / Portland Slag cement, admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, to improve durability and workability without impairing strength including pumping of concrete to site of laying, curing, carriage for all leads but excluding the cost of centering, shuttering, finishing and reinforcement as per direction of Engineer-in-charge for the following grade of concrete. All works upto plinth level : Concrete of M-10 grade with minimum cement content of 220 kg /cum

3	REINFORCED CEMENT CONCRETE WORK
	Form work for RCC work
3.01	Centering and shuttering including strutting, propping etc. and removal of form for
a	Foundations, pile caps, footings, bases of columns, etc. for mass concrete
b	Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc. at all levels and heights.
c	Shelves (Cast in situ) at all levels and heights
d	Columns, Pillars, Piers, Abutments, Posts and Struts at all levels and heights
e	Stairs, (excluding landings) except spiral-staircases at all levels and heights
f	Shuttering in circular work at all levels and heights
g	Edges of slabs and breaks in floors and walls - Under 20 cm wide at all levels and heights
h	Suspended floors, roofs, landings, balconies and access platform. with water proof ply 12 mm thick at all levels and heights
i	Lintels, beams, plinth beams, girders, bressumers and cantilevers. with water proof ply 12 mm thick at all levels and heights
	TMT steel reinforcement for RCC work including piles
3.02	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.
a	Thermo-Mechanically Treated bars of grade Fe-550D or more.
3.03	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete above plinth level at all levels and heights
a	Thermo-Mechanically Treated bars of grade Fe-550D or more.
	Parallel Threaded couplers to TMT vertical reinforcement-bars
3.04	Providing and fixing parallel threaded couplers conforming to IS code-16172:2023 on "Reinforcement Couplers for Mechanical Splices of Bars for Concrete Reinforcement - Specification", to reinforcement bars including threading, enlargement at connection by forging, protecting the prepared reinforcement bars and related operations as required to complete the works per direction of Engineer- in-Charge.
3.4.1	Coupler for 20 mm diameter reinforcement bar
3.4.2	Coupler for 25 mm diameter reinforcement bar
3.4.3	Coupler for 32 mm diameter reinforcement bar

3.05	Providing and laying in position ready mixed or site batched design mix cement concrete for reinforced cement concrete work; using coarse aggregate and fine aggregate derived from natural sources, Portland Pozzolana / Ordinary Portland /Portland Slag cement, admixtures in recommended proportions as per IS: 9103 to accelerate / retard setting of concrete, to improve durability and workability without impairing strength; including pumping of concrete to site of laying, curing, carriage for all leads; but excluding the cost of centering, shuttering, finishing and reinforcement as per direction of the engineer-in-charge;
3.05.1	All works upto plinth level.
	RCC work in Piles, Pile caps, rafts, footings
3.05.1.1	Concrete of M30 grade with minimum cement content of 350 kg /cum
3.05.1.2	Concrete of M35 grade with minimum cement content of 370 kg /cum
3.05.1.3	Concrete of M40 grade with minimum cement content of 390 kg /cum in shear walls, columns
	RCC work in retaining walls, grade slab, beams/plinth beams
3.05.1.4	Concrete of M35 grade with minimum cement content of 370 kg /cum
	RCC work in shear walls, columns, slab, beams, staircases, tanks and all type of structure works
3.05.2	All works above plinth level.
3.05.2.1	Concrete of M35 grade content of 370 kg /cum
3.05.1.2	Concrete of M40 grade with minimum cement content of 390 kg /cum in shear walls, columns
3.06	Waterproofing treatment of grade slab / liquid water retaining structure / substructure in ground
3.06.1	Providing and applying for vertical surface two coats @ 0.70 kg per sqm integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI- 212-3R-2010 i.e. by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage.
3.06.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the horizontal surface one coat @1.10 kg per sqm of RCC structures like retaining walls of the water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI- 212-3R-

	2010 i.e. by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage.
3.07.2	Providing and applying integral crystalline (dry shake) of hydrophilic in nature for waterproofing treatment to the RCC structures like raft, foundation slab, sewage & water treatment plant slab, warehouses floor, parking structures and water tank base slab etc. sprinkled @0.60kg per sqm or higher as recommended by the manufacturer's specification over the lean concrete of above cited structures. The material shall meet the requirements as specified in ACI-212-3R-2010 i.e. by reducing permeability of concrete by more than 85%, compared control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline dry-shake shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the Engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage.
	Polyester fibre for grade slab and liquid retaining structure
3.08	Providing and mixing synthetic Polyester triangular fibre of length 12mm, effective diameter 10-40 microns and specific gravity of 1.34 to 1.40 in cement concrete / RCC / Flooring / water retaining structures by using of 125gms of synthetic Polyester triangular fibre for 50 Kg cement used cement as per directions of Engineer-in-Charge.
3.09	Providing and placing in position suitable PVC water stops serrated with central bulb (225 mm wide, 8-11 mm thick) conforming to IS : 12200 for construction / expansion joints between two RCC members and fixed to the reinforcement with binding wire before pouring concrete etc. complete.
3.10	Providing HDPE membrane 0.8 mm thick below pcc of pile caps/ grade slab.
4	Bored Cast-in-Situ RCC Piles
4.1	Boring, providing and installation of bored cast-in-situ reinforced cement concrete piles of 600 mm dia of concrete grade M-30 of specified diameter and length below the pile cap, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and temporary casing of appropriate length for setting out and removal of same and the length of the pile to be embedded in the pile cap etc. by percussion drilling using Direct mud circulation (DMC) or Bailer and chisel technique by tripod and mechanical Winch Machine all complete, including removal of excavated earth with all its lifts and leads.
	Initial test – minimum 1.5% of total pile per building
4.2	Vertical load testing of piles in accordance with IS 2911 (Part IV) including installation of loading platform by Kentledge/Anchor piles method and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of Engineer in-charge.
	Note: 1. Initial and Routine Load Test shall not be carried out by Dynamic method of testing.
	Note: 2. Testing agency shall submit the design of loading platform for the approval of Engineer-in-charge.
4.3.1	Initial test (Test Load 2.5 times the Safe capacity) - Single pile above 50 tonne and upto 120 tonne Safe capacity (two in each residential blocks and 3 each in Hospital and R&D Blocks) Locations for testing shall be decided by the client.
4.3.2	Routine test (Test Load 1.5 times the Safe capacity) - Single pile above 50 tonne and upto

	120 tonne Safe capacity, (1.5% of the total number of piles in each Block. However, locations of test piles shall be decided by the Client)
	Integrity Test for all piles
4.3	Integrity testing of Pile using Low Strain/ Sonic Integrity Test/ Sonic Echo Test method in accordance with IS :14893 including surface preparation of pile top by removing soil, mud, dust & chipping lean concrete lumps etc. and use of computerized equipment and high skill trained personal for conducting the test & submission of results, all complete as per direction of Engineer-in-charge.
4.4	Pile head Preparation, Chiselling and dressing the pile upto PCC level, Fixing starter shuttering with layout, filling the GP2 Sealing of pile head with waterproof sealing compound in starter, applying bituthene LM around the pile during water proofing with necessary tools etc. complete.
5	PRECAST CEMENT CONCRETE WORK & PLAIN CEMENT CONCRETE FOR SMALL WORKS
5.1	Providing and fixing precast cement concrete in 1:1.5:3 (1 cement : 1.5 coarse sand(zone-III) derived from natural sources : 3 graded stone aggregate 20mm nominal size derived from natural sources) in string or lacing courses, copings, bed plates, anchor blocks, plain window sills, shelves, louvers, steps, stair cases, etc., at all levels including hoisting and setting in position with cement mortar 1:3 (1 Cement : 3 coarse sand), cost of required Centering complete.
5.2	Providing, hoisting and fixing precast reinforced cement concrete work in string courses, bands, copings, bed plates, anchor blocks, plain window sills, small lintels, and the like, including the cost of required centering, shuttering but , excluding cost of reinforcement with 1:1.5:3 (1 cement : 1.5 coarse sand(zone-III) derived from natural sources : 3 graded stone aggregate 20 mm nominal size derived from natural sources) at all levels.
6.	Masonry work
6.01	Providing and laying Autoclaved Aerated concrete (AAC) blocks masonry 200 mm thick with Grade- I AAC blocks in super structure at all levels with RCC band at sill level and lintel level with approved block laying pattern cement mortar 1:4 (1 cement : 4 coarse sand) all complete as per direction of Engineer-in-Charge at all levels and heights as per GFC drawings. RCC bands to be provided as per GFC drawings.
6.02	Providing and laying Autoclaved Aerated concrete (AAC) blocks masonry 100 mm/ 125 mm thick with Grade- I AAC blocks of density 551 to 650 Kg/ cum conforming to IS: 2185 (Parts-3) in super structure at all levels in cement mortar 1:4 (1 cement : 4 coarse sand), at all levels and heights as per GFC drawings. RCC bands to be provided as per GFC drawings.
6.03	Brick work with common burnt clay F.P.S. (non-modular) bricks of class designation 7.5 in foundation and plinth in Cement mortar 1:6 (1 cement: 6 coarse sand)

6.04	Half brick masonry with common burnt clay F.P.S. (non-modular) bricks of class designation 7.5 in superstructure at all levels in cement mortar 1:4. By providing and placing in position 2 Nos 6 mm dia M.S. bars or 1 no 8mm bars at every third course of masonry work.
6.05	Brick work with common burnt clay F.P.S. (non-modular) bricks of class designation 7.5 in superstructure in: Cement mortar 1:6 (1 cement: 6 coarse sand) at all levels.
	Dry Partitions work
6.06	Providing and fixing 75 mm overall thickness partition with 12.5 mm thick double skin fire rated Glass Reinforced Gypsum (GRG) plaster board conforming to IS: 2095: part 3 (Board with BIS certification marks) upto ceiling height consisting of G.I. frame and required board, including providing and fixing of frame work made of special section power pressed/ roll form G.I. sheet with zinc coating of 120 gms/sqm(both side inclusive), consisting of floor and ceiling channel 50mm wide having equal flanges of 32 mm and 0.50 mm thick, fixed to the floor and ceiling at the spacing of 610 mm centre to centre with dash fastener of 12.5 mm dia meter 50 mm length or suitable anchor fastener or metal screws with nylon plugs and the studs 48 mm wide having one flange of 34 mm and other flange 36 mm and 0.50 mm thick fixed vertically within flanges of floor and ceiling channel and placed at a spacing of 610 mm centre to centre by 6 mm dia bolts and nuts, including fixing of studs along both ends of partition fixed flush to wall with suitable anchor fastener or metal screws with nylon plugs at spacing of 450 mm centre to centre, and fixing of boards to both side of frame work by 25 mm long dry wall screws on studs, floor and ceiling channels at the spacing of 300 mm centre to centre. The boards are to be fixed to the frame work with joints staggered to avoid through cracks, M.S. fixing channel of 99 mm width (0.9 mm thick having two flanges of 9.5 mm each) to be provided at the horizontal joints of two boards, fixed to the studs using metal to metal flat head screws, including jointing and finishing to a flush finish with recommended jointing compound, jointing tape, angle beads at corners (25 mm x 25 mm x 0.5 mm), joint finisher and two coats of primer suitable for board as per manufacture's specification and direction of engineer in charge all complete.
6.07	Providing and fixing thermal insulation with Resin Bonded rock wool conforming to IS: 8183, having density 48 kg/m ³ , 50 mm thick, wrapped in 200 G Virgin Polythene Bags fixed to wall with screw, rawel plug & washers and held in position by criss crossing GI wire etc. complete as per directions of Engineer- in- Charge.
7	Steel work
7.01	Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete, as per GFC drawings.
7.02	Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works as per GFC drawings.
7.03	Providing and fixing M.S. tube hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approved steel primer.
7.04	Providing and fixing carbon steel galvanised (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm ²), counter sunk head, comprising of 10 mm dia polyamide PA 6 grade sleeve, including drilling of hole in frame , concrete/ masonry, etc. as per direction of Engineer-in-charge. size 10 x 140 mm

7.05	Supplying and fixing rolling shutter of approved make, made of required size M.S. laths interlocked together through there entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete including the cost of providing and fixing necessary 27.5 cm long wire springs grade no.2 and M.S. top cover of required thickness for rolling shutters. -80 x 1.25mm M.S. laths with 1.25mm thick top cover
7.06	Providing and fixing the M8 x 115 Mechanical Anchor Fasteners of Hilti Make confirming to IS 1367 (Part 3) at required locations and level including drilling the hole, cleaning and anchoring the bolt as per manufacturers specifications etc. complete as directed by Engineer In Charge.
7.07	Providing and fixing the M10 x110 Mechanical Anchor Fasteners of Hilti Make confirming to IS 1367 (Part 3) at required locations and level including drilling the hole, cleaning and anchoring the bolt as per manufacturers specifications etc. complete as directed by Engineer In Charge.
7.08	Providing and fixing the Chemical Anchor Fasteners of Hilti Make confirming to IS 1367 (Part 3) at required locations and level including drilling the hole, cleaning with blow pump and anchoring the bolt with chemical as per manufacturers specifications etc. complete as directed by Engineer In Charge. M10 x 90 foil capsule (HVU) & M10 x 130 Rod
7.09	Providing and fixing the Chemical Anchor Fasteners of Hilti Make confirming to IS 1367 (Part 3) at required locations and level including drilling the hole, cleaning with blow pump and anchoring the bolt with chemical as per manufacturers specifications etc. complete as directed by Engineer In Charge. M12 x 110 foil capsule (HVU) & M12 x 160 Rod
7.10	Providing and Fixing of High grade mild steel Foundation Bolts and nuts in RCC column / pedestal / beam at any level including maintaining the accuracy towards line, level & position including making and using the template etc. complete as directed by Engineer In Charge. (Contractor will take due care for its threads and rusting by applying grease and cotton waste.
8.0	Plastering
8.01	12 mm cement plaster of mix : 1:6 (1 cement: 6 coarse sand) at all heights and levels
8.02	15 mm cement plaster on rough side of single or half brick wall of mix: -1:6 (1 cement: 6 coarse sand) at all heights and levels.
8.04	6-8 mm cement plaster of mix : 1:3 (1 cement : 3 fine sand) on exposed ceiling and Flewing soffits
8.06	Forming groove of uniform size in the top layer of wall / ceiling plaster as per approved pattern , finishing the groove complete as per specifications and direction of the Engineer-in-charge :
8.09	18 mm cement plaster in two coats under layer 12 mm thick cement plaster 1:5 (1 cement : 5 coarse sand) finished with a top layer 6 mm thick cement plaster 1:4 (1 cement : 4 fine sand) on exterior walls upto all heights including providing waterproofing compound in cement mortar including making drip courses.
9.	Flooring work - stone , tiles

9.01	Providing and fixing 18 mm thick gang saw cut, mirror polished, premoulded and prepolished, machine cut Granite stone slab all colour and texture for kitchen platforms, vanity counters, window sills, facias and similar locations of required size, approved shade, colour and texture laid over 20 mm thick base cement mortar 1:4 (1 cement : 4 coarse sand), joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc. complete at all levels.
9.02	Fixing granite stone, over and above corresponding basic item, in facia and drops with epoxy resin based adhesive, including cleaning etc. complete.
9.03	Providing opening of required size & shape for wash basin/ kitchen sink in kitchen platform, vanity counter and similar location in marble/ Granite/ stone work, including necessary holes for pillar taps etc. including moulding, rubbing and polishing of cut edges etc. complete.
9.04	Providing edge moulding to 18 mm thick granite stone counters, Vanities etc., including machine polishing to edge to give high gloss finish etc. complete as per design approved by Engineer-in-Charge. -Granite work
9.05	Providing and fixing 600mm wide 19 mm marine ply base platforms for wash basin counter & fascia including MS angle support frame work fixed to wall, making holes in plywood
9.06	Providing and laying vitrified tiles in floor with water absorption less than 0.08% and conforming to IS: 15622, of approved brand & manufacturer, in all colours and shade, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joints with white cement and matching pigments etc. The tiles must be cut with zero chipping diamond cutter only. Laying of tiles will be done with notch trowel, plier, wedge, clips of required thickness, leveling system and rubber mallet for placing the tiles gently and easily.
9.6.1	Double charge of size of 600mm x 600mm (Approved tiles with basic cost Rs. 560 -600 per sqm landed in Guwahati)
9.6.2	Matt / Antiskid of size of 600mm x 600 mm (Approved tiles with basic cost Rs. 480 -520 per sqm landed in Guwahati)
9.07	Providing and laying Vitrified tiles in different sizes (thickness to be specified by the manufacturer), with water absorption less than 0.08% and conforming to IS: 15622, of approved brand & manufacturer, in all colours and shade, in skirting, dado, riser of steps, laid with cement based high polymer modified quick set tile adhesive (water based) conforming to IS: 15477, in average 6 mm thickness, including grouting of joints Size of Tile 600mm x 600 mm or as per GFC drawings. (Approved tiles with basic cost Rs. 560 -600 per sqm landed in Guwahati)
9.08	Providing and laying Polished Granite stone flooring in required design and patterns, in linear as well as curvilinear portions of the building all complete as per the architectural drawings with 18 mm thick stone slab over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade including rubbing, curing and polishing etc. all complete as specified and as directed by the Engineer-in-Charge. -Polished Granite stone slab colour of Black, Cherry / Ruby Red or equivalent as per GFC drawings (Basic cost of slabs Rs. 2000 to Rs. 2200 per sqm landed in Guwahati as sample approved by Employer)

9.09	Providing and laying Polished Granite stone flooring in required design and patterns, in linear as well as curvilinear portions of the building all complete as per the architectural drawings with 18 -20 mm thick stone slab over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade including rubbing , curing and polishing etc. all complete as specified and as directed by the Engineer-in-Charge. -Polished Granite stone slab of all colour and texture. (Basic cost of slabs Rs. 1200 per sqm landed in Guwahati as sample approved by Employer) Type F4
9.10	Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer) of 1st quality conforming to IS : 15622 of approved designs, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), Jointing with grey cement slurry @ 3.3 kg/sqm including pointing the joints with white cement and matching pigment etc., complete.
9.11	Cement concrete flooring 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slurry, but excluding the cost of nosing of steps etc. complete. - 40 mm thick with 20 mm nominal size stone aggregate
9.12	25mm thick Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand) in areas as per GFC drawings.
9.13	25mm thick semi polished Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, laid with base of cement mortar 1 : 4 (1 cement : 4 coarse sand) as per finishing schedule.
9.15	Providing granite stone flooring in treads of steps and risers using single length up to 2.15 meters and pre finished nosing in treads of steps of granite / Kota stone slab as per finishing schedule.
9.16	Server Rooms Floors - Providing and fixing 450 mm Finished Floor Height (FFH) Access Floor panel of 600x600x32 mm medium grade Filled Steel anti-static high pressure Lamination of 800H grade (FS800H). Access Floor panel shall be steel welded construction with an enclosed bottom pan with uniform pattern of 64 hemispherical cones. The top and bottom plates of Steel Gauges: top 0.6 mm and bottom 0.7mm fused spot welded together (minimum 64 welds in each dome and 20 welds along each flange). The panel should be Corroresist epoxy coated for lifetime rust protection and cavity formed by the top and bottom plate is filled with Pyrogrip non-combustible Portland cementitiouscore mixed with lightweight foaming compound. The access floor shall be factory finished with Anti-static High Pressure laminate with Non Warp technology upto 1mm thickness for superior adhesion and Surface flatness within 0.75mm.The panel is to withstand a Concentrated Load of 363 kgs. applied on area 25mm x 25mm without collapse in the centre of the panel which is placed on four steel blocks. The panel will withstand and Uniformly Distributed Load (UDL) minimum 1250 kg/sqm and an impact load of 50kg all complete as per the approved manufacturers specification and as per the direction of Engineer-in-charge. All specification must be printed on the side of the panel to ensure the quality of the product.
9.17	Grouting the joints of flooring tiles having joints of 3 mm width, using epoxy grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardener and 0.20 kg of resin per kg), including filling / grouting and finishing complete as per direction of Engineer-in-charge. Size of Tile 600x600 mm or as per GFC drawings
9.18	Providing and laying tactile tile (for vision impaired persons as per standards) of size 300x300x9.8mm having with water absorption less than 0.5% and conforming to IS:15622 of approved make in all colours and shades in for outdoor floors such as footpath, court yard, multi modals location etc., laid on 20mm thick base of cement mortar 1:4 (1 cement : 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc. complete as per direction of Engineer-in-Charge.

9.19	Providing Granite / Kota stone in treads of steps and risers using single length and Making 3 grooves in granite / Kota stone slabs on treads or Anti-skid strip self-adhesive type
10.	Wall Dado tiles, skirting, risers
10.1	Providing and fixing 1st quality ceramic glazed tiles conforming to IS : 15622 (thickness to be specified by the manufacturer) of approved make in all colours, shades except burgundy, bottle green, black of any size as approved by Engineer-in-Charge in skirting, risers of steps and dados over 12 mm thick bed of cement Mortar 1:3 (1 cement: 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm including pointing in white cement mixed with pigment of matching shade complete. Size 300mm x 600mm (Approved tiles with basic cost Rs. 340 -380 per sqm landed in Guwahati)
10.2	18 mm thick Cement plaster skirting up to 30 cm height, with cement mortar 1:3 (1 cement : 3 coarse sand), finished with a floating coat of neat cement.
10.4	Kota stone slabs 20 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.
10.5	Providing and laying polished granite stone 18mm thick in skirting / risers on walls with cement mortar 1:4 i/c jointing with polymer based pigment, complete upto 150mm height
10.6	Providing and fixing machine cut, polished, Granite stone work for wall lining including dado, etc., in required design and pattern wherever required, on 12 mm (average) thick cement mortar 1:3 (1 cement : 3 coarse sand) laid and jointed with cement slurry @ 3.3 kg/sqm including pointing with white cement slurry admixed with pigment of matching shade, including rubbing, curing, polishing etc. all complete as per Architectural drawings, and as directed by the Engineer-in-Charge. 18mm to 20mm thick Polished Granite stone slab as per finishing schedule. (Basic cost of slabs Rs. 2000 -2200 per sqm landed in Guwahati as sample approved by Employer)
10.7	Champhering of granite stone edge i/c polishing of skirting, corner
10.8	White sand Stone work, plain in copings, cornices, string courses and plinth courses, upto 75 mm thick in Cement mortar 1:4 (1 cement : 4 coarse sand), including pointing with white cement mortar 1:2 (1 white cement : 2 stone dust) with an admixture of pigment matching the stone shade.
11.	Roofing & Waterproofing
11.1	Brick bat Coba - Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations: (a) Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment. (b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs. (c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge. (d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep.

	With average thickness of 120 mm and minimum thickness at khurra as 65 mm. (e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. "All above operations to be done in order and as directed and specified by the Engineer-in-Charge.
11.2	Providing and fixing ceramic Tiles (600 mm x 600 mm) on waterproof and sloped surface of terrace, laid on 20 mm thick cement sand mortar in the ratio of 1:4 (1 cement : 4 coarse sand) and grouting the joints with mix of white cement. Or Providing and laying Johnson Endura 8mm thick cool roof SRI tiles laid with cement mortar 1:4 in slope (1 cement : 4 coarse sand) and grouting the joints with polymer grout.
11.3	Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.
11.4	Providing PCC gola on roof size upto 35mm x 35mm in CC 1:2:4 mixed with waterproofing compound in sunken area along wall.
11.5	Providing PCC fillet / gola on roof size upto 65mm x 65mm in CC 1:2:4 admixed with waterproofing compound along wall.
11.6	Providing and Laying the flooring of broken China-mosaic (broken pieces of China glazed tiles) of approved colour set in 25 mm. average bed of cement mortar 1:3 with waterproofing compound to correct level and slope (1:100) well compacted and finished; such that minimum coverage of China mosaic chips is about 90% of the total area of slab. The above treatment shall continue along the inner side of parapet or the adjoining wall upto 30 cm. high as per the above specifications regarding cement mortar in shape of round vata with necessary groove etc. complete.
11.7	Providing and laying water proofing treatment in sunken portion of WCs, bathroom etc., by applying cement slurry mixed with water proofing cement compound consisting of applying : (a) First layer of slurry of cement @ 0.488 kg/sqm mixed with water proofing cement compound @ 0.253 kg/ sqm. This layer will be allowed to air cure for 4 hours. (b) Second layer of slurry of cement @ 0.242 kg/sqm mixed with water proofing cement compound @ 0.126 kg/sqm. This layer will be allowed to air cure for 4 hours followed with water curing for 48 hours. Item includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonry with polymer mixed slurry. (contractor to give 10 years guarantee as per form)
11.8	15 mm thick protective cement plaster of mix : 1:4 (1 cement: 4 coarse sand) over waterproofing in sunken areas.
11.9	Providing and laying lean concrete of mix 1:5:10. filling in sunken floor areas including compaction at all levels.
11.10	Providing and applying 2 coats Single component Elastomeric moisture cured polyurethane waterproofing coating shall urethane LHM @ 1.8 kg/sqm i/c preparation of RCC surface and repairing cracks with shall Crete mortar , applying primer on surface on landscape terraces. (contractor to give 10 years guarantee as per form)
11.11	Providing & applying 2 part water based, solvent free, odourless, Food grade epoxy resin coating (primer and seal coatings) in water tanks as per manufacturer's specifications (US FDA approved). This include repair of pot holes, preparation of surface. (contractor to give 10 years guarantee as per form)

11.12	Core cutting : Core cutting upto 150-350mm depth in constructed RCC work of all grades for services as required. 80mm dia / 150mm dia / 250mm dia by mechanical tools.
12.	Door, Window, Glazing work
12.1	Providing and fixing of aluminium Extruded sections of powder coating minimum thickness 50 micron in doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket / sealants etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / panelling, C.P. brass / stainless steel screws, all complete as per architectural GFC drawings and the directions of Engineer-in-charge.
12.1.1	For fixed members, Seasoned 1 st class local hard wood of proper sizes shall be inserted at the locations where hinges shall be fixed.
12.1.2	For shutters of doors, windows & ventilators including providing and fixing hinges / rollers / pivots and making provision for fixing of fittings wherever required
13	Internal doors Shutters
13.01	Providing and fixing ISI marked flush door shutters conforming to IS : 2202 (Part I) non-decorative type, core of block board construction with frame of 1st class hard wood and well matched commercial 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters including cutting of rebates wherever required, providing teak wood lipping and ISI marked Stainless Steel butt hinges with necessary screws.
a	30 mm thick
b	35 mm thick
13.04	Providing & Fixing 1mm thick decorative high pressure laminated sheet of plain / wood grain in gloss / matt/ suede finish with high density protective surface layer and reverse side of adhesive bonding quality conforming to IS : 2046 Type S, including cost of adhesive of approved quality on both and all the edges of flush doors.
13.05	Providing & Fixing Vision panels wherever required with 10mm glass in flush doors i/c cutting of glass as per GFC drawings.
13.06	Providing louvers in flush door shutters wherever required as per GFC Drawings.
13.08	Providing and fixing to door frames 30 mm thick Glass Fibre Reinforced Plastic (FRP) panelled door shutter of all sizes of required colour and approved brand and manufacture, made with fire - retardant grade unsaturated polyester resin, moulded to 3 mm thick FRP laminate for forming hollow rails and styles, with wooden frame and suitable blocks of seasoned wood inside at required places for fixing of fittings, cast monolithically with 5 mm thick FRP laminate for panels conforming to IS: 14856, including fixing to frames. as per GFC drawings.
14	External windows / glazing
14.01	Providing and supplying aluminium extruded tubular and other aluminium sections as per the architectural drawings and approved shop drawings , the aluminium quality as per grade 6063 T5 or T6 as per BS 1474,including super durable powder coating of 60-80 microns conforming to AAMA 2604 of required colour and shade as approved by the Engineer-in-Charge. The item includes cost of material such as cleats, sleeves, screws etc. necessary for fabrication of extruded aluminium frame work.
14.2	Fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the

	building for all heights and all levels, including:
a	Structural analysis and preparation of shop drawings for the specified design loads conforming to IS 875 part III (the system must passed the proof test at 1.5 times design wind pressure without any failure), including functional design of the aluminium sections for fixing glazing panels of various thicknesses, aluminium cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc., structural and weather silicone sealants, flashings, fire stop (barrier)-cum-smoke seals, microwave cured EPDM gaskets for water tightness, pressure equalisation & drainage and protection against fire hazard including:
b	Fabricating and supplying serrated M.S. hot dip galvanised / Aluminium alloy of 6005 T5 brackets of required sizes, sections and profiles etc. to accommodate 3 Dimensional movement for achieving perfect verticality and fixing structural glazing system rigidly to the RCC/ masonry/structural steel framework of building structure using stainless steel anchor fasteners/ bolts, nylon separator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers.
c	Providing and filling, two part pump filled, structural silicone sealant and one part weather silicone sealant compatible with the structural silicone sealant of required bite size in a clean and controlled factory / work shop environment, including double sided spacer tape, setting blocks and backer rod, all of approved grade, brand and manufacture, as per the approved sealant design, within and all around the perimeter for holding glass.
14.3	Providing, assembling and supplying vision glass panels (Insulated Glass Units) comprising of hermetically-sealed, 6-12-6 mm insulated glass (double glazed) vision panel units of size and shape as required and specified, comprising of an outer heat strengthened float glass 6mm thick, of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade, an inner Heat strengthened clear float glass 6mm thick, spacer tube 12mm wide, desiccants, including primary seal and secondary seal (structural silicone sealant) etc. all complete for the required performances, as per the Architectural drawings, as per the approved shop drawings, as specified and as directed by the Engineer-in-Charge. The IGUs shall be assembled in the factory/ workshop of the glass processor. (i) Coloured tinted float glass 6mm thick substrate with reflective soft coating on face # 2, + 12mm Airgap + 6mm Heat Strengthened clear Glass of approved make having properties as visible Light transmittance (VLT) of 25 to 35 %, Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28) and U value of 3.0 to 3.3 W/m ² degree K etc. The properties of performance glass shall be decided by technical sanctioning authority as per the site requirement.
14.4	Openable side / top hung vision glass panels (IGUs) including providing and supplying at site all accessories and hardware's for the openable panels as specified and of the approved make such as heavy duty stainless steel friction hinges, min 4 -point cremone locking sets with stainless steel plates, handles, buffers etc. including necessary stainless steel screws/ fasteners, nuts, bolts, washers etc. all complete as per the Architectural drawings, as per the approved shop drawings, as specified and as directed by the Engineer- in-Charge as per GFC drawings.
14.5	Providing, fabricating and supplying shadow box of required size and shape, for fixing in the spandrel portion of the structural glazing, in linear as well as curvilinear portions of the building by providing semi -rigid, inorganic, non- combustible fibre glass wool insulation 50 mm thick, conforming to IS: 8183 and BS: 3958 Part 5. The insulation layer shall have facing (factory bonded on surface # 1 of the fibre glass insulation layer), of black non-woven fibre glass tissue of nominal thickness 0.5 mm and nominal mass not less than 60 gm / sqm, made of randomly oriented glass fibres distributed in a binder by a wet- lay process including fixing 1.5 mm thick solid aluminium sheet backing using, 6 mm thick cement board including SS rivets, nuts, bolts, washers etc. complete.

14.6	Providing and supplying Spandrel Glass Panels comprising of 6 mm thick heat strengthened monolithic float glass of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade so as to match the colour and shade of the IGUs in the vision panels etc. ,all complete for the required performances as specified, as per the Architectural drawings, as per the approved shop drawings, as specified, and as directed by the Engineer- in- Charge.
14.7	Filling the gap in between aluminium frame & adjacent RCC / Brick/ Stone work by providing weather silicon sealant over backer rod of approved quality as per architectural drawings and direction of Engineer-in-charge complete. Upto 5mm depth and 5 mm width
14.8	Filling the gap in between aluminium/ stone/ wood frame and adjacent RCC / Brick / Stone / wood / Ceramic/ Gypsum work by providing weather / structural non sag elastomeric PU sealant over backer rod of approved quality as per architectural drawings and direction of Engineer-in-charge complete, complying to ASTM C920, DIN 18540-F & ISO 11600 -Upto 5 mm depth and 5 mm width
14.9	Providing and fixing stainless steel (SS 304 grade) adjustable friction windows stays of approved quality with necessary stainless steel screws etc. to the side hung windows as per direction of Engineer-in- charge complete as required size.
14.10	Providing and fixing carbon steel galvanised (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm ²), counter sunk head, comprising of 10 mm dia polyamide PA 6 grade sleeve, including drilling of hole in frame , concrete/ masonry, etc. as per direction of Engineer-in-charge as required size.
14.11	Providing and fixing powder coated extruded Aluminium section in frame (50 micron coating) and louvered shutter as per design.
15	Façade works
15.1	Providing, detailing, composite fabricating members like columns, beams and similar structural steel members fabricated using M.S. hollow tubular steel sections (circular & rectangular pipes), conforming to IS 1239 part 1 and 2 and of grade Fe 250 as per specifications and approved fabrication drawings (which are to be prepared by Contractor and got approved from Engineer), including transportation of the same to site, erection of structural steel members for all heights & at all levels, provision of necessary erection bolts, fixing bolts, nuts, washers, cleats, stiffeners, gussets, base plate, and all necessary operations like preheating as per specifications, straightening, bending, cutting, drilling, grinding, machining if specified, welding, grinding, removing the welding burr and preparing surface for painting with wire brush cleaning and applying two coats of epoxy red oxide zinc phosphate primer of 30 microns each and two coats of Epoxy Corrosion Resistant Enamel paint of 30 microns after fabrication including touching up with spray painting after erection etc. complete as directed by Engineer In Charge.
15.2	Providing , fabricating and fixing aluminium extruded tubular and other aluminium sections in pergolas, louvers as per the architectural drawings and approved shop drawings , the aluminium quality as per grade 6063 T5 or T6 as per BS 1474,including super durable powder coating of 60-80 microns conforming to AAMA 2604 of required colour and shade as approved by the Engineer-in-Charge. (The item includes cost of material such as cleats, sleeves, screws etc. necessary for fabrication of extruded aluminium frame work).
15.3	Providing and fixing 4mm thick powder coated aluminium composite sheet cladding to portal with SS screws and details on external surfaces at all levels over support frame work in elevations.

15.4	Providing and fixing factory made 18 mm thick single extruded WPC (Wood Polymer Composite) solid plain white colour board Jali, CNC (Computer numeric control) routed of approved design by Engineer-in -charge which are machine cut for duct/shaft covering, partitions and facades comprising of virgin polymer of K value 58-60 (Suspension Grade), calcium carbonate and natural fibers (wood powder/ rice husk/wheat husk) and non-toxic additives(maximum toxicity index of 12 for 100 gms) having minimum density of 650 kg/cum and screw withdrawal strength of 1800 N (Face) minimum compressive strength 50 N/mm ² , modulus of elasticity 850 N/mm ² and resistance to spread of flame of Class A category with properties of being termite/borer proof, water/moisture proof and fire retardant and fixing on M.S (mild steel) frame made of 25 x 25 x 1.5 mm square hollow box section including applying a priming coat of approved steel primer, placed at grid made at 1.0 x 1.0 m or as per requirement at site with necessary stainless steel fasteners and SS screws etc., all complete as per direction of Engineer- In- Charge. (M.S (mild steel) framework with priming coat and necessary SS fasteners and SS screws shall be provided.
16	External cladding
16.1	Providing and fixing structural steel frame (for dry cladding) on walls at all heights using M.S. square/ rectangular tube in the required pattern as per architectural drawing, including cost of cutting, bending, welding etc. The frame work shall be fixed to the wall with the help of M.S. brackets/ lugs of angle iron/ flats etc. which shall be welded to the frame and embedded in brick wall with cement concrete block 1:2:4 (1 cement :2 coarse sand :4 graded stone aggregate 20 mm nominal size) of size 300x230x300 mm, including cost of necessary centering and shuttering and with approved expansion hold fasteners on CC/RCC surface, including drilling necessary holes. Approved cramps/ pins etc. shall be welded to the frame work to support stone cladding, the steel work will be given a priming coat of Zinc Chromate primer as approved by Engineer-in-charge and painted with two or more coats of epoxy paint (Shop drawings shall be submitted by the contractor to the Engineer-in-charge for approval before execution). The frame work shall be fixed in true horizontal & vertical lines/planes. Stainless steel cramps shall be provided and fixed as per shop drawings.
16.2	Providing and fixing Large formatted porcelain tiles 1200mm x 2400mm and 6mm thick on external walls with aluminium tubular section work frame work and weather silicon sealant on joints including cost of scaffolding complete as per approved sample in two shades combination .
17.	False Ceilings

17.1	<p>Providing and fixing false ceiling at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes , finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cut-outs made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the Engineer in Charge but excluding the cost of painting with :</p>
a	12.5 mm thick tapered edge gypsum plain board conforming to IS: 2095- (Part I) :2011 (Board with BIS certification marks)
b	12.5 mm thick tapered edge Glass Reinforced Gypsum (GRG) board conforming to IS: 2095- (Part 3):1996 (Boards with BIS certification marks)
c	12.5 mm thick tapered edge gypsum moisture resistant board
d	Fully Perforated Gypsum Plaster Board of size 1200 x 2400x12.5 mm having approx. 15 % perforated area with perforation size and pattern as approved by the Engineer-in-charge and as per manufacturer's specification, with all 4-side tapered and backed by acoustical tissue with NRC value not less than 0.60
17.2	<p>Providing and fixing tiled false ceiling of specified materials of size 595x595 mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/ sqm, both side inclusive) consisting of main "T" runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross "T" of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main "T" at 600 mm center to center to form a grid of 1200x600 mm and secondary cross "T" of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, required cutting/making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main "T" runners to be suspended from ceiling using GI slotted cleats of size 27 x 37 x 25 x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm GI adjustable rods with galvanised butterfly level clips of size 85 x 30 x 0.8 mm spaced at 1200 mm center to center along main T, bottom exposed width of 24 mm of all T-sections shall be pre-painted with polyester paint, all complete for all heights as per specifications, drawings and as directed by Engineer-in-charge.</p>

a	GI Metal Ceiling Lay in perforated Tegular edge global white colour tiles of size 595x595 mm and 0.5 mm thick with 8 mm drop; made of GI sheet having galvanizing of 100 gms/sqm (both sides inclusive) and 20% perforation area with 1.8 mm dia holes and having NRC (Noise Reduction Coefficient) of 0.5, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending and perforation, and backed with a black Glass fiber acoustical fleece.
17.3	Providing and Fixing 15 mm thick densified Tegular edged eco-friendly light weight calcium silicate false ceiling tiles of approved texture of size 595 x 595 mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanised steel sections (galvanising @ 120 grams per sqm including both side) consisting of main 'T' runner suitably spaced at joints to get required length and of size 24x38 mm made from 0.33 mm thick (minimum) sheet, spaced 1200 mm centre to centre, and cross "T" of size 24x28 mm made out of 0.33 mm (Minimum) sheet, 1200 mm long spaced between main'T' at 600 mm centre to centre to form a grid of 1200x600 mm and secondary cross 'T' of length 600 mm and size 24 x28 mm made of 0.33 mm thick (Minimum) sheet to be inter locked at middle of the 1200x 600 mm panel to form grid of size 600x600 mm, resting on periphery walls /partitions on a Perimeter wall angle pre-coated steel of size (24x24x3000 mm made of 0.40 mm thick (minimum) sheet with the help of rawl plugs at 450 mm centre to centre with 25 mm long dry wall screws @ 230 mm interval and laying 15 mm thick densified edges calcium silicate ceiling tiles of approved texture in the grid, including, cutting/ making opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc., wherever required. Main 'T' runners to be suspended from ceiling using G.I. slotted cleats of size 25x35x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm G.I. adjustable rods with galvanised steel level clips of size 85 x 30 x 0.8 mm, spaced at 1200 mm centre to centre along main 'T', bottom exposed with 24 mm of all T Sections shall be pre-painted with polyester baked paint, for all heights, as per specifications, drawings and as directed by Engineer-in-Charge.
17.4	Providing and fixing GI Clip in Metal Ceiling System of 600x600 mm module which includes providing and fixing 'C' wall angle of size 20x30x20 mm made of 0.5 mm thick pre painted steel along the perimeter of the room with help of nylon sleeves and wooden screws at 300 mm center to centre, suspending the main C carrier of size 10x38x10 mm made of G.I steel 0.7 mm thick from the soffit with help of soffit cleat 37x27x25x1.6 mm, rawl plugs of size 38x12 mm and C carrier suspension clip and main carrier bracket at 1000 mm c/c. Inverted triangle shaped Spring Tee having height of 24 mm and width of 34 mm made of GI steel 0.45 mm thick is then fixed to the main C carrier and in direction perpendicular to it at 600 mm centers with help of suspension brackets. Wherever the main C carrier and spring T have to join, C carrier and spring T connectors have to be used. All sections to be galvanized @ 120 gms/sqm (both side inclusive), fixing with clip in tiles into spring T with :
a	GI Metal Ceiling Clip in plain Bevelled edge global white colour tiles of size 600x600 and 0.5 mm thick with 25 mm height, made of G I sheet having galvanizing of 100 gms/ sqm (both sides inclusive) and 20% perforation area with 1.8 mm dia holes and having NRC of 0.5, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending and perforation.
17.5	Providing and fixing tiled false ceiling of specified materials of size 595x595 mm in true horizontal level, suspended on interlocking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/ sqm, both side inclusive) consisting of main "T" runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross "T" of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main "T" at 600 mm center to center to form a grid of 1200x600 mm and secondary cross "T" of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, required cutting/making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main "T" runners to be suspended from ceiling using GI slotted cleats

	<p>of size 27 x 37 x 25 x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm GI adjustable rods with galvanized butterfly level clips of size 85 x 30 x 0.8 mm spaced at 1200 mm center to center along main T, bottom exposed width of 24 mm of all T-sections shall be pre-painted with polyester paint, all complete for all heights as per specifications, drawings and as directed by Engineer-in-charge.</p>
a	<p>8 mm thick fully perforated calcium silicate board made with Calcareous & Siliceous materials reinforced with cellulose fiber manufactured through autoclaving process to give stable crystalline structure with minimum compressive strength 225 kg/ sq. cm, bending strength 100 kg/sq. cm , of size 595x595 mm, having perforation of dia. 10 mm with minimum perforated area 18 % with non-woven tissue on the back side, having an NRC (Noise Reduction Coefficient) of 0.85, with 50 mm thick rockwool of 48 kg /cum backing.</p>
17.6	<p>Providing & fixing false ceiling with 8 mm thick Calcium Silicate Board made with Calcareous & Siliceous materials reinforced with cellulose fiber manufactured through autoclaving process.at all height including providing & fixing of framework made of special section, power pressed from M.S. sheets and galvanised with zinc coating of 120 gms/ sqm (both side inclusive) as per IS : 277 and consisting of angle cleat of size 25mm wide x 1.6mm thick with flanges of 27mm and 37mm, at 1200mm c/c, one flange fixed to the ceiling with dash fastener 12.5mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25 x10 x0.50mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I channels 45 x15 x 0.90mm running at the spacing of 1200 mm c/c, to which the ceiling section 0.5mm thick bottom wedge of 80mm with tapered flanges of 26 mm each having lips of 10.5mm, at 450mm c/c, shall be fixed in a direction perpendicular to G.I intermediate channel with connecting clip made out of 2.64mm dia x 230mm long G.I wire at every junction, including fixing perimeter channels 0.50mm thick 27mm high having flanges of 20mm and 30mm long, the perimeter of ceiling fixed to wall/ partitions with the help of Rawl plugs at 450mm centre, with 25mm long dry wall screws @ 230mm interval, including fixing of Calcium Silicate Board to ceiling section and perimeter channels with the help of dry wall screws of size 3.5 x25mm at 230mm c/c, including jointing & finishing to a flush finish of tapered and square edges of the board with recommended jointing compounds, jointing tapes, finishing with jointing compounds in three layers covering up to 150mm on both sides of joints and two coats of primer suitable for boards, all as per manufacture's specification and also including the cost of making opening for light fittings, grills, diffusers, cut outs made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the Engineer in charge.</p>
17.7	<p>Providing and making cove in gypsum board ceiling size 150mm wide and upto 250mm height at all heights</p>

17.8	<p>Providing and fixing mineral fibre false ceiling tiles With 20 mm thick bevelled tegular mineral fibre false ceiling tile (NRC 0.7) at all heights of size 595X595mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance $\geq 85\%$, Thermal Conductivity $k = 0.052 - 0.057 \text{ w/m K}$, Fire Performance as per (BS 476 pt - 6 &7) in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanized@80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size 24x24x3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the engineer-in-charge.</p>
17.9	<p>Providing and fixing wooden finish U Baffle Aluminium panel ceiling of different colours and finish supplied by approved manufacturers, consisting of panel size 50 mm width X 100 mm deep using 0.6 mm thick, panel length upto 4 mtr, Coil Coated on a Continuous Paint Line, Double baked and roll formed from enamelled corrosion resistance Aluminium alloy AA 3005 (Al. Mg) for higher strength and good roll forming characteristics. Aluminium panels shall be chromatised for maximum bond between metal and paint enamelled twice under high temperature, Exposed side with a full primer and finish coat on a Continuous Paint Line. Panels shall be clipped to a baked enamelled Aluminium carrier of 30 mm wide x 47 mm high x 0.5 mm thick, Black Colour coated, one leg of the carriers with cut outs to hold the panels in a module of 150 mm. Panel carrier shall be suspended by means of threaded rod at a distance of 1.8 mtr c/c. Actual distance of threaded rod/carrier might vary and to be calculated based on the actual drawing and site condition. The measurements shall be wall to wall without any deductions for lights, diffuses, columns etc. Ceiling area above U Baffle should be painted in black colour or any other colour as per the architect for better aesthetics before fixing this system.</p>

17.10	<p>Providing and fixing Rock Fiber (Bio-Safe) Acoustical (NRC Upto 0.9) Micro Look Edge False Ceiling Tile at all heights of size 595X595mm of approved texture, design and pattern. Rock Wool Tile should have Acoustical Tissue Paper on the top face and harden edge to achieve NRC-0.80 as per ASTM C-423/ISO 354. The tiles should have Anti-Bacterial coating & Passed the Test Method as per JIS Z 2801: 2010, Should passed resistance to fungal attack test as per ASTM:G21-15. Relative Humidity (RH) more than 85%, Fire Performance as per Vertical flammability test (UL94) Classification V1 (Flame extinguishes within 30 seconds with no dripping) in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.30 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm (Black Silhouette) of length 3000 mm, cross T of size 15x32mm (Black Silhouette) of length 1200 mm and secondary intermediate cross T of size 15x32 mm (Black Silhouette) of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised@80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size 22x19x3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights. (Supplier Company should be OEM and same Test Certificates will be required.</p> <p>The work shall be carried out as per specifications, drawings and as per directions of the engineer-in-charge.</p>
17.11	<p>Providing and fixing trap door in the Gypsum board / POP ceiling system for electrical and mechanical utilities with 18mm thk. plywood shutter and 12mm thk. teak wood lipping all around including wooden / G.I. frame with supports, fixtures, fastenings etc. complete as directed.</p>
18	Painting
18.1	<p>White washing with lime to give an even shade : New work (three or more coats) in lift hafts, service shafts</p>
18.2	<p>Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.</p>
18.3	<p>Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface: Water thinnable cement primer on exterior surfaces.</p>
18.4	<p>Distempering with oil bound washable distemper of approved brand and manufacture to give an even shade: New work (two or more coats) over and including water thinnable priming coat with cement primer as per finishing schedule</p>
18.5	<p>Finishing walls with water proofing cement paint of required shade : New work (Two or more coats applied @ 3.84 kg/10 sqm) on inner surface of parapet wall.</p>
18.6	<p>Finishing walls with textured exterior paint of required shade : New work (Two or more coats applied @ 3.28 ltr/10 sqm) over and including priming coat of exterior primer applied @ 2.20kg/10 sqm.</p>
18.7	<p>Finishing walls with Acrylic Smooth exterior paint of required shade : New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)</p>

18.8	Finishing walls with 100% Premium acrylic emulsion paint having VOC less than 50 gm/litre and UV resistance as per IS 15489:2004, Alkali & fungal resistance, dirt resistance exterior paint of required shade (Company Depot Tinted) with silicon additives on New work (Two or more coats applied @ 1.43 litre/ 10 sqm. Over and including priming coat of exterior primer applied @ 0.90 litre/10 sqm.
18.9	Painting with synthetic enamel paint of approved brand and manufacture to give an even shade -Two or more coats on new work of walls in white colour
18.10	Painting with synthetic enamel paint of approved brand and manufacture to give an even shade -Two or more coats on new work of walls in different dark colour
18.11	Supply and applying of low VOC , highly washable , water based sanitizing Ultrasatin (D-11205) anti-bacterial coating application to all kind of surface and enhancing protection against bacteria for Hygienic environment and conforming to JIS Z 2801:2100 test Protocols for Anti- Bacterial Coatings test. The material should be reactive curing acrylic resin water based coating . The antibacterial painting system shall be one coat of water based acrylic primer after that apply two coats of water based Ultrasatin (D-11205) Anti-bacterial coating over smooth putty surface preparation & scaffolding , apply by roller/brush/spray as per approved colour & shades, all complete as per manufacturer's specification with the direction of Engineer in charge
18.12	Painting 2 coats of matt finish enamel paint on plaster / RCC ceiling with spray machine
19.	Fire doors
19.1	Providing and fixing Hollow metal fire rated doors confirming to BS 476 part 20& 22 , IS 3614 part-1 & part-2 for stability and integrity with Pressed Galvanized steel confirming to IS 277 with doors tested at CBRI/ NABL approved lab for maximum rating of 2hrs tested Glass used for vision panels to be supported by certificates confirming the required fire ratings /panels being a part of the fire door assembly. The Doors should be finished in Thermosetting Powder Coating desired RAL Shades and Fire Coating primer with VOC Content for Flat: <50g/l, non-flat: < 150 g/l. All Hardware should pass European certificate "CE" of conformity / UL with required fire ratings. Door frame shall be double rebate profile of minimum size 143mm X 57 mm made out of min 1.6mm minimum thick galvanized steel sheet. NDRF 143x57 Frames shall be Butt jointed and field assembled with self-bolted. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening.
19.2	Providing and fixing panic bar / latch (Double point) fitted with a single body, Trim Latch & Lock on back side of the Panic Latch of reputed brand and manufacture to be approved by the Engineer- in- charge, all complete.
19.3	Providing and fixing floor spring BTS 75V EN 1-4 with std. spindle and cover plate. The floor spring with backcheck and adjustable closing speed from 175° . With 90° . hold open. As per EN 1154. (not suitable for fire doors) Finish: Satin stainless steel. Application - Aluminium Doors.
19.4	Providing and fixing External trim PHT 05F for PHA, PHB Panic Hardware for fire and smoke check doors. For max. 60mm thick door prepared for euro profile cylinder. Silver finish.

19.5	Providing and fixing fire resistant door frame of section 50 x 60 mm on horizontal side & 35 x 60 mm on vertical sides having built in rebate made out of 1.6 mm thick GI sheet (Zinc coating not less than 120gm/m ²) suitable for mounting 120 min Fire Rated Glazed Door Shutters. The frame shall be filled with Mineral wool Insulation having density min 96Kg/m ³ . The frame will have a provision of G.I. Anchor fasteners 14 nos (5 each on vertical style & 4 on horizontal style of size M10 x 80) suitable for fixing in the opening along with Factory made Template for SS Ball Bearing Hinges of Size 100x89x3mm for fixing of fire rated glazed shutter . The frame shall be finished with an approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in-charge .
19.6	Providing and fixing of 72mm thick fire cum acoustic door shutter for AHU rooms as per NBC 2016.
19.7	Supply & fixing Automatic door bottom RP8si seal from Raven, extruded silicon sealing component, spring loaded to lift clear of the floor. Concealed mounted in a 15mm x 34mm groove. Max gap 13mm. Finish: Anodised satin clear. L=820mm. As per the directions of Engineer-in-charge
19.8	Supply & fixing RP 38Si, Automatic Door Bottom Seal, Heavy Duty, Face Mounted Version, spring loaded to lift clear of the floor as soon as the door leaf is opened, suitable to be used on Fire and smoke check doors, Seal Material = Silicon, Finish = Anodized Satin Clear, Length = 36". As per the directions of Engineer-in-charge
19.9	Supply & fixing Delta RP 120- Long Double Dorset Seal for acoustic, fire and smoke protection, suitable for wooden and steel frames, self-adhesive, Finish = Black, Length = 1 x 2000mm, Height- 2 x 2750mm.
19.10	Supply & fixing galvanised mechanical door coordinator for 2 leaf fire door shutters – surface mounted / concealed as per requirement.
19.11	Providing and fixing carbon steel galvanised (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm ²), counter sunk head, comprising of 10 mm dia polyamide PA 6 grade sleeve, including drilling of hole in frame , concrete/ masonry, etc. as per direction of Engineer-in-charge. size 10 x 120 mm
20	Hardware
20.1	Providing and fixing 250mm x 10mm aluminium tower bolts, ISI marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade, with necessary screws etc. complete :
20.2	Providing and fixing aluminium die cast body tubular type universal hydraulic door closer (having brand logo with ISI, IS : 3564, embossed on the body, door weight upto 35 kg and door width upto 700 mm), with necessary accessories and screws etc. complete.
20.3	Providing and fixing bright finished 100 mm mortice lock with 6 levers with pair of handles of approved quality for aluminium door, with necessary screws etc. complete as per direction of Engineer- in-charge.
20.4	Providing and fixing 125 mm bright /matt finished Stainless Steel handles of approved quality & make with necessary screws etc. all complete.
20.5	Providing and fixing 100 mm bright /matt finished Stainless Steel handles of approved quality & make with necessary screws etc. all complete.

20.6	Providing and fixing bright finished brass hanging type floor door stopper with necessary screws, etc. complete.
20.7	Providing and fixing powder coated aluminium handle for windows 125mm long with locking arrangement
20.8	Providing and fixing DEC 6Plus 6 Pin Euro Profile Double Cylinder with Both side Key operation Under Master Key System. Total Length = 60mm (30mm+30mm)Change Keys - 3 Nos. Finish - Nickel Plated.
20.9	Supply and fixing of Interlayered FR Glass of minimum 11 mm thick interlayered , 120 minutes fire Rated (EW120, EI 15 minutes) Non Wired, Toughened Interlayered Glass of approved make which can also withstand thermal shock upto 800 degree centigrade shall be used as a glazing (Vision Panel Top/side fixed glazing) and is to be fixed in between the glass beading by using ceramic fiber in accordance with BS : 476 Part 22/ EN 1363 EN 1364 for stability and integrity of size 300 mm x 300mm (Clear vision) and the manufacturer should have tested the glass of similar or bigger size with any type of door framing from CBRI Roorkee .
20.10	Providing and fixing Mortice dead lock 278a with 55mm back set, 20mm square forend and prepared for euro profile cylinder including strike plate in satin stainless steel as per EN 12209.
20.11	Providing and fixing 5 Knuckle, 2 bearing butt hinges size 4" x 3" x 3mm, in SS 304 and in satin stainless steel. As per EN 1935, CE Marked. Suitable for door weights upto 120kgs.
20.12	Providing and fixing Male/female sign plate 3020-M for WC application with fixing screws size 125 x 125mm, rounded corners in SS 304 satin stainless steel finish. Marking in black
20.13	Providing and fixing handicapped person toilet sign plate 3020-M for WC application with fixing screws size 125 x 125mm, rounded corners in SS 304 satin stainless steel finish. Marking in black
20.14	Providing and fixing pull Handle Length 300mm, 22mm dia, -SS304 TGDI-D 300 back to back with adjustable fixing for glass, wood and metal doors in satin stainless steel. The pull handles should have supporting washer with raised bevelling on the outer surface.
20.15	Providing and fixing pull Handle Length 600mm, 32mm dia, -SS304 TGDI-D 600 back to back with adjustable fixing for glass, wood and metal doors in satin stainless steel. The pull handles should have supporting washer with raised bevelling on the outer surface.
20.16	Providing and fixing pull handle TGDI 9356 350mm back to back Offset pull handle, adjustable fixing for glass, wood and metal doors in satin stainless steel. The pull handles should have supporting washer with raised bevelling on the outer surface. Length =350mm, 25mm dia, -SS304
20.17	Providing and fixing pull handle TGDI-D 300 Single Side with adjustable fixing for glass, wood and metal doors in satin stainless steel. The pull handle should have supporting washer with raised bevelling on the outer surface. Length =300mm, 22mm dia, -SS304
20.18	Providing and fixing SS handle 150mm x 20mm for Janitor (single)

20.19	Supply & fixing TS 92 B contour, cam action door closer with G-N slide channel arm for pull side fixing. Spring size EN 2-4 as per EN 1154 and CE marked. Silver finish.
20.20	Providing and fixing BB 4330, 5 Knuckle, 2 Ball bearing butt hinges size 4" x 3" x 3mm, in SS 304 and in SSS finish. Suitable for door weights upto 120kgs. Template Drilled
20.21	Providing and fixing Pure 8100 Type 1 Package with Pair of Pure 8100 Design Lever Handle on Roses & escutcheons. Including 271a Sash lock with 72mm CTC, 55mm Back set 20mm Square forend. EPC 60mm length both side key operation
20.22	Providing and fixing floor stop half dome with 45mm dia with fixing accessories, in satin Chrome
20.23	Providing and fixing 3006, 6 pin Euro profile half cylinder with one side key operation standard length 42mm in satin nickel plated finish with 3 keys.
20.24	Providing and fixing Surface Mounted SS Tower bolt of Length 150mm in Satin finish
20.25	Providing and fixing Surface Mounted SS Tower bolt of Length 250mm in Satin finish
20.26	Providing and fixing 300 x 10mm stainless steel (Grade 304) tower bolts approved equivalent with necessary screws etc. complete.
20.27	Providing and fixing glass door floor lock with fixing accessories, in satin Chrome
20.28	Supply & fixing Rack and pinion door closer EN size 2/3/4, with std. arm and with two independent closing valves and latching speed adjustable by arm, Door leaf width upto 1100mm, door weight 100 kg, Silver finish. As per EN 1154.
20.29	Providing and fixing Fire rated door closer rack and pinion TS 71 EN size 3/4, with std. arm and with two independent closing valves and latching speed adjustable by arm. Full plastic cover. Silver finish. As per EN 1154.
20.30	Providing and fixing kick plate 1020-3 height 300mm and thickness 0.9mm in SS 304 grade in satin stainless steel with smoothened edges and rounded corners flush face fixing screws. Length=5mm short of the shutter width. Max door width =1200mm (To be fixed on push side of the doors)
20.31	Providing and fixing Pure 8100 Type 3 Package with Pair of Pure 8100 WC Design Lever Handle on Roses & escutcheons 7122. Including 275a WC lock with 78mm CTC, 55mm Back set 20mm Square forend.
20.32	Providing and fixing mop plate 1010-1 with smoothened edges and rounded corners flush face fixing screws height 150mm and thickness 0.9mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width. Max door width =900mm
20.33	Providing and fixing lock with Ellen key for Janitor door
20.34	Providing and fixing steel (white power coated) crescent lock for sliding window/ door with necessary screws etc. complete.
20.35	Providing and fixing C aluminium channel with rollers for sliding door in handicapped toilets with necessary screws etc. complete.
20.36	Providing and fixing chrome plated chain and hook.
20.37	Providing and fixing Magic eye as per approved sample.

21	Stainless steel railing & Laminated Glass Railings
21.1	Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners , stainless steel bolts etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge,
21.2	Providing and fixing 1050mm high Laminated toughened glass railing (8 mm clear glass + 1.52 mm pvb film + 8 mm clear glass) with SS 316 adaptor & SS 316 balusters i/c edge polishing of glass.
21.3	Providing, Supply & installation Glass Railing of top mounted SS 304 Grade satin finished railing for Straight Area made by using SS Top rail (1)50x1.5 mm Thk. mounted on SS baluster made of SS round tube baluster (OZBF-CM-44-GH) of (1)50 x 2 mm thick with SS modular swivel neck to the top rail. The total height of the installed rail including top rail will be 800 mm from FFL. Further the baluster will be mounted on 100X100x8 mm thick SS 304 grade base plate fixed on the RCC floor with 4 nos. of M8 x 90 mm long GI stud anchors with SS Nut Caps. The baluster will hold 13.5 mm thk. laminated glass connected to the baluster with the help of CNC made modular glass holders, The average spacing of baluster will be 900 mm. The railing will includes all accessories for lop Rail joints. All material need to be in SS 304 grade with satin finish only , including drilling of hole in frame , concrete/ masonry etc. as per direction of Engineer-in-charge.
21.4	Providing and fixing single pipe stainless steel (Grade 304) railing made of Hollow tubes, etc., including welding, grinding, buffing, polishing and making curvature (wherever required) i/c fixing the railing with necessary accessories & stainless steel dash fasteners , stainless steel bolts etc., of required size, on the walls / in corridor covering glass panels, as per approval of Engineer-in-charge.
22.	Wall Panelling
22.1	Providing and Fixing "Wood grained sound slats panelling" wall panelling of channelled Wood panels of width 200mm, thickness of 16 mm and length 2440 mm, made up of high density moisture resistant fibre board with minimum density of 800 Kg/m ³ substrate with a laminated facing of wood veneer as per the approved shade / species & finish with melamine balancing layer on the reverse side. The boards shall have a special perforation pattern of 4 mm groove & 28 mm pitch. The panels shall have fire resistance of Class I, BS 476 part 7. The edges of the panels shall be —tongued-and-grooved to receive special clips for installation. The back of the perforated panel shall have sound absorbing non-woven acoustical fleece and backed with 50mm thick glass wool layer as directed by the Engineer-in-Charge. The panel shall be mounted on special channels using clips as approved by the Engineer -in-charge. Install G.I stud of section 48X34X36 mm or as approved by the Engineer -in- Charge on the solid wall horizontally using screws and plugs at spacing of 600mm centre to-centre. Screw the aluminium channel (keel) vertically on channelled G.I stud 600mm centre to centre. Install the first set of wooden panels by inserting the clips. For border channel insert the groove of the panel in to the projecting flange of the aluminium clip. Continue installing rows of panels by inserting the tongue into the groove of the earlier inserted panel and progressively installing clips for inside channel into the next aluminium channel (keel) and simultaneously fill the gap between wall & panel by 50 mm thick rockwool having density of 48 kg/m ³ . Continue the process till the actual height is achieved. Use clips for border channel to finish off the installation, finish the edges using

	wood moulding of matching colour as approved by Engineer-in- Charge. The installed panels should give an NRC minimum of 0.9.
22.2	Providing and installation of acoustical wall panelling wood finish Slats made out of HDF board , Melamine / veneer laminated finish, perforated wooden grooved slats (2mm grooves @ 8mm centers) / (2mm Slats @16mm pitch) / (2mm grooves @ 32mm centers) / (2mm grooves @ 64mm centers), backlined with black acoustical fleece, tongue-groove edge for a seamless look, FR grade, of lineal dimension size 128mm x 2440mm x 16mm thick having density 1000Kg /m ³ , weight 12.8Kgs/m ² installed by using GI strut system. The GI strut system includes GI Cross channel having thickness 0.45mm, length 3600mm, knurled web 40mm, depth 10mm and equal flanges 15mm is fastened vertically/ horizontally at every 600mm centers. Aluminium core cross channel having thickness 0.5mm, length 2400mm, web 15mm and 27mm, depth 18mm and flanges of 7mm with suitable edge and centre brackets is then fixed perpendicular to the cross channel with the help of fasteners at every 400mm centers. Contractor to Provide expansion joints of 3mm at every 5mts both ways.
22.3	Providing and fixing 6mm thick High Pressure Interior compact Laminate of made out of thermosetting resin treated Kraft as core material and design paper as a finish surface. Compact laminates should have the characteristic of flame retardant fulfilled the criteria of under BS-476/97 and EN438-6 with classification of BS1D0 standard property, Anti-bacterial and anti-termite property under JIS Z2801:2000, Chemical resistance, Scratch resistant ,fire resistance, weather & climatic shock resistance(The manufacturer should provide 10 years warranty certification on any manufacturing and moisture related defects.)The compact laminates should be resistance to water immersion through permissible increase on thickness and mass <0.60% and board should have density >1.35kg/cm ³ and fulfilled the criteria of FSC and Green Guard Gold certification and manufactured under EN438-2&3:2005 standard . Finish and colour of compact laminates should be finalized under direction of Engineer –in-charge. Compact laminates should be installed on 25x50mm aluminium tube or approved tube size at 600mm c/c under desirable height and fixed through same compact colour rivets or compact adhesive as per recommended by compact supplied agency. Finish and colour of Interior clade should be approved under engineer-in-charge direction.
22.4	Providing and fixing frame work for partitions/ wall lining etc. made of 50x50x1.6 mm hollow MS tube, placed along the walls, ceiling and floor in a grid pattern with spacing @ 60 cm centre to centre both ways (vertically & horizontally) or at required spacing near opening, with necessary welding at junctions and fixing the frame to wall/ ceiling/ floors with steel dash fasteners of 8 mm dia, 75 mm long bolt, including making provision for opening for doors, windows, electrical conduits, switch boards etc., including providing with two coats of approved steel primer etc. complete, all as per direction of Engineer-in-charge.
22.5	Providing and fixing plain lining with necessary screws/nuts & bolts/ nails, including a coat of approved primer on one face, and fixed on wooden /steel frame work, complete as per direction of Engineer-in- charge. 12mm thick commercial ply conforming to IS : 1328 BWR type
23	Glazed doors / glass panels
23.1	Providing and fixing 12 mm thick frameless toughened glass door shutter of approved brand and manufacture, including providing and fixing top & bottom pivot & double acting hydraulic floor spring type fixing arrangement and making necessary holes etc. for fixing required door fittings, all complete as per direction of Engineer-in-charge. Door handle, lock and stopper etc. as per GFC drawings.
23.2	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge including aluminium snap beading With float glass panes of 5 mm thickness (weight not less than 12.50 kg/sqm)

23.3	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge including aluminium snap beading With float glass panes of 8 mm thickness (weight not less than 20 kg/sqm)
23.4	Providing and fixing frameless mirror 6mm thick with bevelled edges fixed on walls with SS studs as required.
23.5	Providing and fixing Frameless mirror 6mm thick with bevelled edges fixed on 9mm thick waterproof plywood with 3 M tape size 600mm x 900mm
23.6	Providing and fixing 6 mm thick toughened glass glazing in glazed door / windows.
23.7	Providing and fixing 12 mm thick frameless toughened glass glazing fixed with powder coated aluminium U channel in floor and ceiling i/c filling with silicon sealant after placing backer rod.
23.8	Providing & fixing of 8mm thick lacquered glass shall be annealed premium GRIHA rated of approved colour by engineer-in-charge, fixed with compatible neutral core silicon / double sided tape on a perfectly levelled 12mm thick water proof plywood / MDF, which is mounted on the RCC wall / any other structure. Lacquered glass must be made industrially (via curtain coating process); opaque (if viewed against a support wall), coated with PU lacquer (25 micron thick); colour consistency (measured by Minolta spectrophotometer CM5081); highly durable (passes PERSOZ hardness test for minimum 220 oscillations); humid resistant (conforms to BS EN 1036 1999); environmentally friendly (no lead, no arsenic, no copper, no formaldehyde); appropriate recycled content (12% post-industrial / 6% post-consumer); compressive strength (1000 MPa) & tensile strength (40 MPa), same as float glass to all complete for all heights as per specifications, drawings and as directed by Engineer-in-charge.
24	Cabinet works
24.1	Providing & fixing 470mm high 580mm deep wash basin under counter cabinets made from laminated plywood with 0.8 mm laminate on all exposed surfaces, TW edging on all board faces, including cost of box, openable shutter, shelves and hardware as per design
24.2	Providing & fixing both side laminated shutters 25mm thick for janitor shutters with hard wood frame 50mm x 50mm , SS piano hinges, SS finish handles and sliding lock.
25	Rest room Cubicles & Urinal privacy panel
25.1	Providing & fixing of modular toilet cubicles size -1150 (W) x 1500(D) x 2250 (H), Door size is 800(W) x 2250(H) consisting of high pressure 12 mm thick compact laminated board as per IS 2046 (Indian Standards) and as per fire retardant BS-476/97 standards with phenolic core panels for partitions of intermediate divider, doors and pilasters, head rail on top of panels and panels shall be fixed on the floor with a clearance of maximum 150 mm using stainless steel satin finish adjustable legs screwed to the floor.) including providing and finishing stainless steel (SS) lock set, SS door knob, SS gravity self-closing hinge, SS coat hook with door stopper, SS U channel, SS head rail, SS adjustable foot, SS tabular holder, SS head rail wall bracket, SS head rail corner connection and SS noise reducing tape, etc.(all SS accessories shall be of Grade 304) as per direction of Engineer-In charge.
25.2	Providing & fixing 12mm HDF laminated board partition of standard size fixed with SS clamps.

26.	Works around MGPS room
26.1	Providing and fixing G.I. chain link fabric fencing of required width in mesh size 50x50 mm Made of G.I. wire of dia. 4 mm, PVC coated to achieve outer dia not less than 5 mm in required colour and shade including strengthening with 2 mm dia wire or nuts, bolts and washers as required complete as per the direction of Engineer-in-charge.
26.2	Painting New work (Two or more coats) on kerb stone / apron marking with adequate nos of coats to give uniform finish with road marking paint of superior make as approved by the Engineer-in-charge, i/c cleaning the surface of ail dirt, scales, oil, grease and other foreign material etc. and lining out complete.
26.3	Supplying and fixing Angle iron post & strut of required size including bottom to be split and bent at right angle in opposite direction for 10 cm length and drilling holes upto 10 mm dia. etc. complete for fixing chain link fencing including synthetic enamel painting.
26.4	62 mm thick cement concrete flooring with concrete hardener topping, under layer 50 mm thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) and top layer 12mm thick cement hardener consisting of mix 1:2 (1 cement hardener mix : 2 graded stone aggregate, 6mm nominal size) by volume, hardening compound mixed @ 2 litre per 50 kg of cement or as per manufacture's specifications. This includes cost of cement slurry, but excluding the cost of nosing of steps etc. complete.

Note : The schedule of items mentioned above are indicative and not exhaustive, Any item not stated under this section but shown in the GFC drawings / Particular specifications shall deemed to be included under the scope of this item.

SCOPE OF WORK, SCHEDULE OF ITEMS & PARTICULAR SPECIFICATIONS
- EXTERNAL DEVELOPMENT WORKS

S.No.	Item	Particulars
9.00	BOUNDARY WALLS & GUARD HOUSES WITH GATES, PORTALS	
9.01		Boundary wall Mild steel railing and grills duly painted with synthetic enamel paint shall be provided as per architectural design in Boundary wall and in other common circulation areas as indicated in drawings and in accordance with provisions of NBC 2016 as per Schedule.
9.02		Boundary wall RCC piles and plinth beam as per GFC drawings
9.03		Boundary wall Polished Granite stone in copings as per GFC drawings
9.04		Entrance gates MS entrance gates with RCC / Steel support structure etc. duly painted with synthetic enamel paint
11.0	ROAD WORK	All roads will be either bitumen or cement concrete roads (as per drawings), as per MORTH specifications (fifth edition), laid over sub grade duly prepared with power roller of required thickness as per design. Irrespective of whether shown in drawings or mentioned in tender document, all the drainage, signages (Informative, Mandatory, Regulatory etc.) other works associated with road works shall be provided as per relevant standards and specification MORTH Specifications for Road and bridge work (Fifth Revision). The edges of roads should be at least 20 cm above the adjoining ground level. The work shall be carried out using MORTH Specifications.
11.1	Good earth / sand filling in plot	Supplying, stacking, spreading, filling of good earth / sand at site including royalty and carriage, compaction in layers with road roller from existing site level to new formation levels as shown in GFC master plan drawings, complete
11.2	Levelling of ground	Ground to be levelled as per Level sheet / as per GFC drawings.
11.3	Subgrade for roads, fire tender path, parking area	Preparation and consolidation of sub grade with power road roller of 8 to 12 tonne capacity after excavating earth to an average of 22.5 cm depth, dressing to camber and consolidating with road roller including making good the undulations etc. and re-rolling the sub grade and disposal of surplus earth.
11.4	Granular Sub base for fire tender path, parking area	Construction of granular sub-base of 150mm thickness by providing close graded Material conforming With material conforming to Grade-I (size range 75 mm to 0.075 mm) having CBR Value-30, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer- in-Charge.
11.5	Granular Sub base for fire tender path, parking area	Construction of granular sub-base of 100mm thickness by providing close graded Material conforming With material conforming to With material conforming to Grade-II (size range 53 mm to 0.075 mm) having CBR Value-25, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer- in-Charge.

11.6	Dense Graded Bituminous Macadam on roads	150mm thick average compacted thickness Dense Graded Bituminous Macadam 50 to 100 mm with bitumen of grade VG-30 @ 5% (percentage by weight of total mix) and lime filler @ 2% (percentage by weight of Aggregate) prepared in Batch Type Hot Mix Plant of 100-120 TPH capacity using crushed stone aggregates of specified grading, premixed with bituminous binder and filler, transporting the hot mix to work site by tippers, laying with paver finisher equipped with electronic sensor to the required grade, level and alignment and rolling with smooth wheeled, vibratory and tandem rollers as per specifications to achieve the desired compaction and density, complete as per specification's and directions of Engineer-in-Charge.
11.7	Seal coat on roads	Providing and laying seal coat of premixed fine aggregate (passing 2.36 mm and retained on 180 micron sieve) with bitumen using 128 kg of bitumen of grade VG - 10 bitumen per cum of fine aggregate and 0.60 cum of fine aggregate per 100 sqm of road surface, including rolling and finishing with road roller all complete.
11.8	Bituminous concrete 50mm thick on roads	Providing and laying Bituminous concrete 50 mm compacted thickness with bitumen of grade VG-30 @ 5.5% (percentage by weight of total mix) and lime filler @ 3% (percentage by weight of Aggregate) prepared in Batch Type Hot Mix Plant of 100-120 TPH capacity using crushed stone aggregates of specified grading, premixed with bituminous binder and filler, transporting the hot mix to work site by tippers, laying with paver finisher equipped with electronic sensor to the required grade, level and alignment and rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction and density as per specification, complete and as per directions of Engineer-in-Charge.
11.9	Tack Coats on roads	Providing and applying tack coat using hot straight run bitumen of grade VG - 10, On W.B.M. @ 0.75 Kg / sqm including heating the bitumen, spraying the bitumen with mechanically operated spray unit fitted on bitumen boiler, cleaning and preparing the existing road surface as per specifications :
11.10	Road marking on roads, parking, fire tender path area	Providing and applying 2.5 mm thick road marking strips (retroreflective) of specified shade / colour using hot thermoplastic material by fully/ semi-automatic thermoplastic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater and profile shoe heater, driven by experienced operator on road surface including cost of material, labour, T&P, cleaning the road surface of all dirt, seals, oil, grease and foreign material etc. complete as per direction of Engineer-in-charge and accordance with applicable specification
11.11	Concrete Kerb Stone	150mm thick 300mm high minimum - Providing and laying at or near ground level factory made kerb stone / Mountable Kerb of M-25 grade cement in position to the required line, level and curvature jointed with cement mortar 1:3 (1 cement : 3 coarse sand) including making joints with or without grooves (thickness of joints except at sharp) curve shall not to more than 5mm)including making drainage opening wherever required complete etc. as per direction of Engineer -in-in charge. Precast C.C. Kerb stone shall be approved by Engineer -in-Charge)
11.12	Saucer Drain for roads, fire tender path, parking	Providing and fixing in position M-30 grade Precast concrete Saucer Drain channel of size 300 mm wide fixed on 20 mm thick 1:4 (1 cement: 4 coarse sand) cement mortar.
11.13	Grass pavers in external areas	Supplying and laying Grass Track Grass Pavers, Green honeycomb panels with self-anchoring pegs, made of high impact resistant HDPE. Each grass paver should be of 330mmx330mm X35 mm in height consisting of four floral shaped structure of 125mm open cell and nine round cell opening of 45mm dia. Each of the open cell are connected With a web like structure for strength and stability. Base of the panel is equipped with a slot opening for drainage and four round struts for anchoring purpose. The Grass Paver to have interlock system to lock each other. The Grass Paver should have compressive strength of minimum

		150 tons/sqm, capable to take the load of the fire tender. The panel should have high level of porosity greater than 90%,porous for Grass, shrubs and low planters. Laying to be done on 50 mm sand bed over well compacted subbase as per manufacturer specifications and directions of Engineer in charge.
11.14	Concrete Pavers blocks in parking areas	Providing and laying factory made chamfered edge Cement Concrete paver blocks 80mm thick of M-30 grade with approved colour design and pattern in footpath, parks, lawns, drive ways or light traffic parking etc, of required strength, thickness & size/shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of sand, compacting and proper embedding / laying of inter locking paver block into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver block as per required size and pattern, finishing. Complete all as per direction of Engineer-in-Charge.
11.15	Pathways surface excavation & Toe walls trenches of plaza	Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30cm in depth. 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, as directed by Engineer-in-charge.
11.16	Soiling below pathways	Providing and Laying 150mm thick water bound macadam sub-base with brick aggregate and binding material, earth etc. including screening, sorting and spreading to template and consolidation with light power road-roller etc. complete.
11.17	CC pavements for pathways	150mm thick unless otherwise specified in GFC drawing, Design mix cement concrete of M-30 grade shall be laid as per drawings, in roads/ parking, using coarse sand and graded stone aggregate of 20 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/ tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction/ expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants etc. complete as per specifications and directions of Engineer-in-charge.
11.18	Cement concrete pavers 60mm thick for pathways	Providing and laying factory made chamfered edge Cement Concrete paver blocks 60mm thick of M-30 grade with approved colour design and pattern in footpath, lawns, etc, of required strength, size/shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of sand, compacting and proper embedding/laying of inter locking paver block into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver block as per required size and pattern, finishing and sweeping extra sand. Complete all as per direction of Engineer-in-Charge.
11.19	Polished granite stone 30mm thick in paving's, bands	Supplying and laying of 30mm thick Polished steel grey & Sira grey granite in Paving and bands with stone/granite, fixed over a bed of 20mm thick CM 1:4 mixed with Cebex 112 inclusive of joints are finished / pointing neatly with pigment to match the colour of stone or approved shade, making holes / cut-outs if any, curing etc., complete at all levels, as per drawings. including cost of materials, labour, Wastages, Tools & Tackles, cleaning, curing, housekeeping etc., complete, all as per specifications, directions & instructions of Engineer-in-charge. including working at all heights with lead & lift etc. complete. Champhering, clamp, pins, anchor fasteners, sealant, groove cutting, edge polishing, below 300mm to be done as per details.
11.20	Polished granite stone 30mm thick in paving's, bands Adhunik brown	Supplying and laying of 30mm thick Polished steel Adhunik Brown granite in Paving and bands with granite, fixed over a bed of 20mm thick CM 1:4 mixed with Cebex 112 inclusive of joints are finished / pointing neatly with

	colour	pigment to match the colour of stone or approved shade, making holes / cut-outs if any, curing etc., complete at all levels, as per drawings. including cost of materials, labour, Wastages, Tools & Tackles, cleaning, curing, housekeeping etc., complete, all as per specifications, directions & instructions of Engineer-in-charge. including working at all heights with lead & lift etc. complete. Champhering, clamp, pins, anchor fasteners, sealant, groove cutting, edge polishing, below 300mm to be done as per details.
11.21	Brick walls for toe walls, plaza below plinth	Brick work with common burnt clay FPS (non modular) bricks of class designation 7.5 in foundation and plinth in:- Cement mortar 1:6 (1 cement : 6 coarse sand)
11.22	Brick walls for toe walls, plaza above plinth	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure above plinth level in all shapes and sizes in Cement mortar 1:4 (1 cement : 4 coarse sand)
11.23	Polished granite stone 30mm thick in paving's, bands Tan brown colour	Supplying and laying of 30mm thick Polished steel Tan Brown granite in Paving and bands with granite, fixed over a bed of 20mm thick CM 1:4 mixed with Cebex 112 inclusive of joints are finished / pointing neatly with pigment to match the colour of stone or approved shade, making holes / cut-outs if any, curing etc., complete at all levels, as per drawings. including cost of materials, labour, Wastages, Tools & Tackles, cleaning, curing, housekeeping etc., complete, all as per specifications, directions & instructions of Engineer-in-charge. including working at all heights with lead & lift etc. complete. Champhering, clamp, pins, anchor fasteners, sealant, groove cutting, edge polishing, below 300mm to be done as per details.
11.24	Drain Cell	Drain Cell shall be of 20mm thickness (Weight Over 2Kg/sq.mtr) consisting of High strength Polypropylene module having size of 500mm x 250mm and 20mm height with interlocking tabs. The Drain Cell to have compressive strength of over 120 tons/sq.mtr and weight of more than 2kg/sq.mtr. Drain Cell to be laid by interlocking individual modules their by covering the entire area. Drain Cell to be covered with Geotextile 150 GSM with 200mm overlap before laying planting soil. Laying to be done as per manufacturer instructions.
11.25	Water body	Construction of water body with RCC piles, pile caps, RCC raft and walls with reinforcement, form work, waterproofing as shown in GFC drawings.
11.26	Waterbody floor and wall finishing	Providing polished Black granite finish 18-20mm thick (Basic cost of slabs Rs. 2000 to 2200 per sqm landed in Guwahati as sample approved by Employer)
11.27	Water body Copings	Providing leather finish Black granite on coping laid with cement mortar.
11.28	Fountain system	Supply and erecting fountain system with 6 nozzles as per GFC drawings including piping, valves etc complete.
11.29	Stepped seating	Brick work in cement mortar 1:4 and sand stone seating as per GFC
11.30	Feature wall	As per GFC drawings
11.31	Sand pits	As per GFC drawings
11.32	Mild steep pergolas	Providing Mild steel pergolas as per GFC drawings consisting of posts, purlins with RCC foundations, plinth beams and mild steel painted with epoxy primer and 2 coats of exterior epoxy paint
11.33	Tensile canopy	Providing tensile canopies made from PVC coated polyester fabric Ferrari or equivalent make as shown supported on Hot dipped galvanised steel posts, purlins structures with RCC foundations, plinth beams.

11.34	Amphitheatre	Amphitheatre made with PCC lean concrete, Brick work in steps in cement mortar 1:4, 40mm thick sand stone steps etc.
11.35	Cement Concrete (M30 grade) tactile tile	Such as directional, warning or hazardous (for vision impaired persons as per standards) of size 300x300x60 mm {60 mm base + (5mm ± 0.5mm) thick raised portion} having water absorption ≤ 6% and conforming to IS: 13801, of approved make in all colours (preferably yellow) and shades for footpath should be laid on 20mm thick base of cement mortar 1:4 (1cement : 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc. (The thickness of wearing layer should not be less than 8mm) and as per harmonized guidelines and space standards for barrier free built environments for persons with disability and elderly persons issued by Ministry of Urban Development, Govt. of India.
11.36	Coloured, preferably yellow PU - Tactile	Coloured, preferably yellow PU - Tactile Studs Warning / Positional with 1 stem having stem dia of 6.0 mm & stem length between 20 - 25 mm, as ground surface indicators shall be provided for the visually impaired persons, on the pedestrian pathway as per manufacturers design / specification and as per Harmonised guidelines
11.37	Coloured, preferably yellow PU - Tactile strips	Coloured, preferably yellow PU - Tactile strips (Guiding) with 3 stems having stem dia of 6.0 mm & stem length between 20 - 25 mm, as ground surface indicators shall be provided for the visually impaired persons on the pedestrian pathway as per manufacturers design / specification and as per harmonized guidelines.
11.38	WMM base	Providing, laying, spreading and compacting graded stone aggregate (size range 53 mm to 0.075 mm) to wet mix macadam (WMM) specification 200mm thick including premixing the material with water at OMC in for all leads & lifts, laying in uniform layers with mechanical paverfinisher in sub- base / base course on well prepared surface and compacting with vibratory roller of 8 to 10 tonne capacity to achieve the desired density, complete as per specifications and directions of Engineer-in-Charge.
11.39	Granite Cobble stone	Providing and fixing 10x10x7.50 cm Granite stone block hand cut and chisel dressed on top, for paving in floors, drains etc. laid over 20mm thick base mortar 1:4 (1 cement : 4 coarse sand) with joints 10mm wide filled with same mortar including ruled pointing etc. complete as per direction of engineer-in-charge.
11.40	Angle for fencing	Supplying at site Angle iron post & strut of required size including bottom to be split and bent at right angle in opposite direction for 10 cm length and drilling holes upto 10 mm dia. etc. complete.
11.41	Granite cladding	Providing and laying gang saw cut 18 mm thick, mirror polished pre moulded and pre polished machine cut granite stone of required size and shape of Black colour and texture in cladding, in water body walls, toe alls plazas and similar locations, laid with 20mm thick base of cement mortar 1:4 (1cement : 4 coarse sand) including grouting the joints with white cement mixed with matching pigment, epoxy touch ups etc. complete as per direction of Engineer-in-Charge.
11.42	Hume pipe	Minimum 300mm dia NP3 / HDPE pipe of required diameter including testing of joints as per specification shall be provided at road crossings.
11.43	Catch Pits	Cross drain catch pits as per GFC drawings

Note : The schedule of items mentioned above are indicative and not exhaustive, Any item not stated under this section but shown in the GFC drawings / Particular specifications shall deemed to be included under the scope of this item.

NIT No- AGIHF/Executing Agency/2024-25/01 date 27.08.2024

**SCOPE OF WORK, SCHEDULE OF ITEMS & PARTICULAR SPECIFICATIONS
- SIGNAGE WORKS**

Item	Description of item
	EXTERNAL SIGNAGE
SIGNAGES	Signages inside / outside building shall be as per NBC 2016 guidelines and of approved design and make with LED backlit. Each room shall be provided with Name Boards, Numbering of rooms, Signages etc. The contractor shall prepare the detailed shop drawing in compliance to the NBC 2016 guidelines and disable friendly building norms of MoHUA.
Entry exit totem size 1220 x 5000 x 300 mm	Providing and fixing at location a signs M.S internal hollow tube structure - Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) International standards, with Lifetime warranty under normal working conditions. Sign is including all extruded aluminium profiles including i) 4 base profiles mill finished glossy appearance or texture, base profile with slots to accommodate 50x 50 mm , 100x50 mm or 150x 50 mm,(to create max depth of 200 mm from either of the combination after mounting base & cover profiles, M.S structure & 'V' notch groove to guide self-tapering screws, directly to be screwed with ,Internal M.S structure with help of stainless steel high tensile strength zinc coated self-tapering CSK screws (length as per requirement) ii) 4 cover profiles of elliptical shape premium anodised with intel- locating facility with base profile for positioning. to be screwed with base profile (screws not visible from outside) after cover profile is mounted to base iii) Top & bottom ACP edge profile premium grade anodised to cover edges of ACP free mounting without drilling or screwing. iv) ACP connect profile with minimum display free mounting without locking & drilling. etc. ,Ultra violet print on ACP or ACRYLIC sheet can be done. Also, arrangement is done to (ACP or Acrylic 3 mm thick can be Inserted in totem profile slots). Top hat asper profile shape (aluminium 2-3 mm thick) is used to cover top part, 2mm thick opaque white acrylic(or clear)can be pasted on text panels as numbers with help of 3M make adhesive. Also LED (Back lite) modules or edge lite modules. Totem profiles screwed fixed with internal M.S structure are installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.
Name Board	Name Boards for buildings shall be of GFC drawings and make (like suitable gauge, 2 feet height SS 304 lettering) with LED backlit.
Signage	Signage works include providing and fixing Building Entrance signage / Tactile Layout / Emergency Evacuation Layout on the wall or with any other required structure, with provision of multilingual text integral with 4mm thick blue Acrylic base plate with min 0.5 mm Aluminium sheet at the back with Upper Case San Serif words made of white acrylic non glare cut out letters of height 15mm, raised above base plate by not less than 0.8mm and the equivalent word/s written in Hindi / any language as required with same specifications with Grade 1 Braille to be integral with the sign face and should be raised 0.5mm above Acrylic base plate. Min Size of the above signboards shall not be less than 1200mm X 750 mm.
	INTERNAL SIGNAGE
Internal Navigation Totem 600 x 1800 x 100mm	Providing and fixing at location a signs made up of I sign -display signage with 100 mm depth Aluminium extrusion Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15- 20 microns) Flatness & Twist of profile within 1.5 mm / meter length, with Lifetime warranty under normal working conditions. Media accommodation depth of 8 mm available for pasting on dual lock or strong two way adhesive. M.S fabrication slot of 65 mm depth for internal M.S structure. Media upto 6 mm thickness can be pasted or mounted with help of dual lock tape .assembled totem can be edge lite with help of edge lite modules or back lite with help of back lite modules. Totem profiles screwed fixed with internal M.S structure are installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.

<p>Door Name plate Sign 400 x 125 x 12 mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is single sided with 1 aluminium profile click fitted on 2 plastic moulded endcaps. Sign is including all plastic injection moulded end caps black in shade which are directly press fitted ,media can be flat bed UV printed on panels/ profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
<p>Room Number sign 450 x 156 x 12mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is single sided with 1 aluminium profile click fitted on 2 plastic moulded endcaps. Sign is including all plastic injection moulded end caps black in shade which are directly press fitted ,media can be flat bed UV printed on panels/ profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
<p>Changeable Snap Frames - 451 x 625 x 20 mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign flip profiles with 32 mm visible border. Sign has high quality plastic moulded base with slightly flexible in nature, with wall mounting screw position hidden beneath the flip profiles. and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
<p>Closet Door Sign - 400 x 125 x 12 mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is single sided with 1 aluminium profile click fitted on 2 plastic moulded endcaps. Sign is including all plastic injection moulded end caps black in shade which are directly press fitted ,media can be flat bed UV printed on panels/ profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
<p>Toilet Door Sign - 156 x 156 x 12</p>	<p>Providing a signs made of Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet)with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is single sided with aluminium profile click fitted on 2 plastic moulded endcaps. Sign is including all plastic injection moulded end caps black in shade which are directly press fitted ,media (vinyl) wrapping by virtue of design of profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
<p>Lift Door Sign - 250 x 187 x 12mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is single sided with 1 aluminium profile click fitted on 2 plastic moulded endcaps. Sign is including all plastic injection moulded end caps black in shade which are directly press fitted ,media can be flat bed UV printed on panels/ profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>

<p>Floor Directory Sign - 750x1500x15 mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is including all plastic injection moulded clips black in shade which are sided in side tracks ,media can be flat bed UV printed on panels/ profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
<p>Main Directory Sign - 1000x2000x15mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is including all plastic injection moulded clips black in shade which are sided in side tracks ,media can be flat bed UV printed on panels/ profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
<p>Lift In case of Fire Sign - 350x 156 x 12 mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is single sided with 1 aluminium profile click fitted on 2 plastic moulded endcaps. Sign is including all plastic injection moulded end caps black in shade which are directly press fitted ,media can be flat bed UV printed on panels/ profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
<p>Floor Number Sign - 400 x 125 x 12 mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is single sided with 1 aluminium profile click fitted on 2 plastic moulded endcaps. Sign is including all plastic injection moulded end caps black in shade which are directly press fitted ,media can be flat bed UV printed on panels/ profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
<p>Fire extinguisher - 300x156x12 mm</p>	<p>Providing a signs made as using Modular Aluminium extrusions (Alloy 6060 as per European standards EN755-2-2008 tensile strength 190 MPa typical BHN is 70 from virgin aluminium homogeneous billet) with Premium grade Anodizing (Thickness 15-20 microns) as per International standards, with Lifetime warranty under normal working conditions. Sign is single sided with 1 aluminium profile click fitted on 2 plastic moulded endcaps. Sign is including all plastic injection moulded end caps black in shade which are directly press fitted ,media can be flat bed UV printed on panels/ profiles. MPI panels fitted and installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>

<p>Emergency Exit Sign -310x225x55 mm</p>	<p>Providing ready sign & fixing at location emergency exit sign- illuminated, surface mount (wall or ceiling) Dual sided made up of plastic material , battery backup of 3 hours (180 mins) .Battery life of 300 cycles of charge & discharge Li- ion battery 3.7 Volt, 100 mA, Charge time of 24 hours. Input voltage 220-240 Volt A.C, 50/60 Hz. Viewing distance 30 meter, degree of protection IP20 (rating for protection against solid object upto 12 mm) white light colour full back (white colour) LED illumination with green white coloured graphic inserted on both sides on 0.4 mm PC (sizes, texts, symbols or graphics as per standard safety norms & regulations) graphic options of -left ,right, up staircase down staircase. Test faculty button self-test plus auto self-test, operation in maintained and non-maintained mode (power saver mode).Sign with 12 months warranty for electric circuit & 6 months warranty for battery. Sign provided with dual mounting arrangement of mounting on wall & ceiling both (with flat rigid support/base).Sign is including all connection wires (upto 1 mtr) & high tensile strength zinc coated self-tapering screws (4 nos with screw wall plastic packing), installed at site in plumb and level at specified location as per drawing to the satisfaction of the engineer-in-charge.</p>
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Note : The schedule of items mentioned above are indicative and not exhaustive, Any item not stated under this section but shown in the GFC drawings / Particular specifications shall deemed to be included under the scope of this item.

**SCOPE OF WORK, SCHEDULE OF ITEMS & PARTICULAR SPECIFICATIONS
- HORTICULTURE WORKS**

2	Item	HORTICULTURE WORKS
		Horticulture and landscaping shall be carried out as per GFC horticulture plan and specifications.
22.1	Site clearance	Clearance of site, removal of bushes, vegetation etc.& disposal of same outside the project site as directed.
22.2	Dressing, Trenching	Dressing, Trenching in soil for tree plantations
22.3	Removing weeds	Removing weeds from soil of plot
22.4	Supply of good earth	Supply and stacking of good earth at site by mechanical transport, loading - unloading including royalty and carriage with all lead and lifts for plantation from outside of approved quality for all areas.
22.5	Cattle manure	Supply and stacking of cow dung manure at site by mechanical transport, loading- unloading including royalty and carriage with all lead and lifts
22.6	Chemical fertilizer	Supplying and applying of chemical fertilizer – Urea / Ammonium Sulphate / Potassium Sulphate or Murate of Potash / Bone meal Filling pits with prepared manure soil (ratio 1 sludge plus 2 good earth by vol.) supply transportation & mixing of soil improvement nutrients including manure as required and inside coat of Chlorpyriphos 30% EC (DE-NOCIL) in all pits flooding with water, dressing including removal of rubbish & surplus earth if any with all leads & lifts, planting.
22.7	Mixing and filling	Mixing and filling, spreading good earth & manure for plot.
22.8	Digging holes	Digging holes for plants and back filling earth
22.9	Planting Shrubs / climbers / Ferns	CLERODENDRUM INERME / DURANTA GOLDEN / FICUS PANADA / HAMELIA PATTENS / PLUMBAGO CAPENSIS / RHAPIS EXCELSA / HIBISCUS ROSA-SINENSIS / LOROPETALUM / MURRAYA EXOTICA / CAESALPINIA PULCHERRIMA / FURCRAEA FOETIDA
22.10	Planting trees	BAUHINIA PURPUREA / TERMINALIA MANTALY / CASSIA FISTULA / CASSIA SIAMEA / FICUS NITIDA TOPIARY / ERYTHRINA INDICA / JACARANDA MIMOSIFOLIA / MELALEUCA BRACTEATA / SCHLEICHERA TRIJUGA
22.11	Pit / Bed filling	12" in depth. Filling bed with prepared manure soil (ratio 1 sludge + 2 good earth by vol.) supply transportation & mixing of supply transportation & mixing of soil improvement nutrients including manure as required and inside coat of Chlorpyriphos 30% EC (DE-NOCIL) in all pits flooding with water, dressing including removal or rubbish & surplus earth if any with all leads & lifts, planting & staking in full & final location including all locations specified maintenance of plants for period of 12 months replacement of any dead & sickly plants in this period, supply & spraying of insecticides as required.

22.12	Planting Grass / ground covers	Pusa Selection / Mound Area
22.13	Planting Palms	WASHINGTONIA FILIFERA / DYPsis LUTESCENS
22.14	Maintenance during DL period	Maintenance for 1 year of Horticulture works during defect liability period

Note : The schedule of items mentioned above are indicative and not exhaustive, Any item not stated under this section but shown in the GFC drawings / Particular specifications shall deemed to be included under the scope of this item.

**SCOPE OF WORK, SCHEDULE OF ITEMS & PARTICULAR SPECIFICATIONS
- FURNITURE WORKS**

18.1	item	SCOPE OF WORK, SCHEDULE OF ITEMS, PARTICULAR SPECIFICATIONS FOR FURNITURE - HOSPITAL BLOCK as per GFC drawings / schedule
18.1.1	Waiting Area Chairs 3 seater without cushion	Track Waiting Area Chairs MS Powder coated Supplying and placing in position of a mild steel visitor bench. The complete mild steel bench has seat & back single section, per seat length is @ 520 mm & seating height is @ 406 mm from ground. owing to the smooth finish, durability and tensile strength beam made of mild steel 1.6mm thick. Seat is made by 1.2mm thick mild steel border with chrome plating for every seat & back; mild steel handles chrome plated & die pressed legs at the end of chairs. Gross weight of regular 3-seater will be 31 kg. The steel grade 202 high yield strength as per is:513 & is:304 grade.
18.1.2	Waiting Area Chairs 3 seater with Leatherite cushion	Track Waiting Area Chairs MS Powder coated With Cushion Supplying & placing in position of metal bench Three Seater. Size Is 1765Mm(L)X 690Mm(D)X 775Mm(H). The Complete Mild Steel Bench Has Seat & Back Single Section. Per Seat Length Is @ 520 Mm & Seating Height Is @ 430 Mm From Ground . Owing To The Smooth Finish, Durability And Tensile Strength Beam Made Of Mild Steel with black powder Coating. Seat Is Made By 1.80Mm Thick Mild Steel Border With Chrome Plating For Every Seat& Back ; Mild Steel Handles Chrome Plated & Die Pressed Legs At The End Of Chairs. Gross Weight Of Regular 3-Seater Will Be 31 Kg. The Steel Grade 202 High Yield Strength As Per Is:513 & Is:304 Grade. The seat and back cushion upholstered with Leatherite cushion thickness 40mm and back 6mm fitted with 6mm ply with foam.
18.1.3	Standard Medium Back chairs	Standard Mesh Chair, Medium Back Chair Dimension: 585 W x 660 D x 1060 H mm. Seat depth: 500mm, Back Height: 490mm Supplying, and placing in position of medium back 360°-degree revolving chair. The chair made of full mesh in black colour. It will come in matte finish about style type is gf nylon structure with nylon net on back. details: arms: fixed pp armrest. Use of ply: 12 mm thick hot pressed BWR plywood (is grade - 303 for seat). Seat: 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cu meter for best quality cushioning in seat, Back: frame of design shall be curved made of two pieces injection moulded frame cover with mesh. backrest support adjustable lumbar support Mechanism: single locking mechanism. Gas lift 100 mm telescopic hydraulic. Base: 650mm nylon base with smooth castors
18.1.4	Premium High back mesh chairs	Premium Mesh Chair, High Back Chair Dimension: 640 W x 670 D x 1350 H mm. Seating Height: 540mm, Seat depth: 500mm, Back Height: 815mm Supplying, and placing in position of high back 360°-degree revolving chair, the chair made of full mesh in black colour. It will come in matte finish about style type is modern. details: Arms: armrest is having two adjustment heights (up & down). Use of ply: 12 mm thick hot pressed BWR plywood (is grade - 303 for seat).Seat: 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cu meter for best quality cushioning in seat, Back: frame of design shall be curved made of two pieces injection moulded frame cover with mesh. backrest support adjustable lumbar support Mechanism: self-weighted multi locking

		mechanism. Only seat size is 500mm(l)x 500mm(d)x 540-440mm(h) & the back size is 480mm(l)x 815mm(h), seat maximum height is 540mm & minimum height is 440mm & back height from floor maximum height is 1350mm & minimum height is 1250mm. Gas lift 100 mm telescopic hydraulic. Base: 650 mm chrome prong base is 620mm pitch centre Dia (660mm with castors).
18.1.5	Premium Leatherite High Back Chair	Premium Leatherite Chair, High Back Dimension: 660W x 520 D x 1250 H mm. Seat depth: 520mm, Back Height: 690mm Supplying, and placing in position of high back chair made of full Leatherite in black colour. It will come in matte finish in contemporary style. details: Arms: fixed arms p.p. connected with seat and back. Use of ply: 12 mm thick hot pressed BWR plywood (is grade - 303 for seat and back). Seat: 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cu meter for best quality cushioning in seat, Back: 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cu meter for best quality cushioning in back. backrest support foam design based on symmetrical lumbar support, Mechanism: centre tilt mechanism. Only seat size is 530mm(l)x 535mm(d)x 545mm(h) & the back size is 615mm(l)x 730mm(h) seat maximum height is 545mm & minimum height is 445mm & back height from floor maximum height is 1230mm & minimum height is 1130mm, Gas lift 100 mm telescopic hydraulic, Base: 650mm nylon base with 55 mm castors wheels 360 - degree swivel
18.1.6	Low back Fabric chairs	Fabric Chair, Low Back Dimension: 490 W x 360 D x 820 H mm. Seating Height: 480mm, Seat depth: 360mm, Back Height: 360mm Mindfully designed with movable writing pad and storage tray, the Brilliant chair stays true to its name. The premium soft fabric wraps its streamlined profile for a comfortable seating experience during your training sessions or waiting hours. *The chair made of full fabric in black colour. It will come in matte finish in contemporary style. details: Arms: fixed armrests with half writing pad. Use of ply: 12 mm thick hot pressed BWR plywood (is grade - 303 for seat and back). Seat: 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cu meter for best quality cushioning in seat, Back: 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cu meter for best quality cushioning in back. backrest support foam design based on symmetrical lumbar support Only seat size is 490mm(l)x 360mm(d)x 480mm(h) & the back size is 400mm(l)x 360mm(h), seat height is @ 480mm. Base: 4 legs metal powder coated frame with paper tray
18.1.7	Fabric Sofa Cum Bed with Hydraulic storage	Fabric Sofa Cum Bed with Hydraulic Storage Dimension: 2350 W x 1575 D x 940 H mm. Seating Height: 460mm Supplying, and placing in position sofa cum bed with button-tufted cushions, and dual USB port. The chaise lifts up to reveal ample storage. With an ingenious trundle mechanism, the sofa front pulls out and up, Material & Subtype: Fabric - Polyester, Frame Material: Plywood, Solid Wood, Upholstery Material: Fabric - Linen, Seat Material: Fabric - Linen, Finish: Matte

18.1.8	Leatherite Manual Recliner 1 seater	Leatherite Manual Recliner, 1 Seater Size: 800 W x 980 D x 990 H mm. A contemporary tailored profile seamlessly blends form and functionality. Wrapped in sumptuous Leatherite, Dylan invites indulgent lounging with its plush cushioning and sloped arms. While the recline pull tab makes lounging easy for all generations. Material & Subtype: Premium Leatherite, Frame Material: Solid Wood, Upholstery Material: Premium Leatherite, Filling Material: Loose Fiber, Foam, Rounding Spring, Seat Material: Premium Leatherite, Finish: Matte, Colour & Colour Family: Brown, Mechanism: Manual, Seating Height: 495mm
18.1.9	Office Desk Table 1500mm width with side unit 1050mm	Office Desk Table Size: 1500 W x 600 D x 750 H mm. & Side Unit Size: 1050 W x 450 D x 750 H mm. Supplying and placing Main Table side combo storage . The Worktop is made of 25mm thick Prelaminated particle board with 2 mm thick PVC Lipping on the edges. The worktop is supported on U Shape Metal Legs 50mm x 50mm , powder coated under structure with Laminate Modesty panel. The Metal legs are connected by Metal Beams for stability and . The Table tops should have metal inserts on underside for modularity. The screw used should be blunt headed and not sharp headed for metal to metal coupling . Colour as per direction of Engineer in Charge. Side Storage unit is made of combination of hinged door unit and 3 Drawer unit - Storage body is made of 18mm thick pre laminated particle Board conforming to IS : 12823. The back of the unit is made from 18mm pre laminated board. All the exposed edges are with 2mm PVC edge Imported banding & sealed edges are with 0.8mm thick PVC Imported edge banding. The top, side and hinged shutters are sealed with 2mm thick PVC edge banding. Storage has adjustable shelves inside and cam lock, tower bolt and locking strips.
18.1.10	Office Desk Table 1200mm width with side unit 1050mm and 3 Drawer pedestal Unit	Office Desk Table Size: 1200 W x 600 D x 750 H mm. & Side Unit Size: 1050 W x 450 D x 750 H mm. Supplying and placing Main Table side combo storage . The Worktop is made of 25mm thick Prelaminated particle board with 2 mm thick PVC Lipping on the edges. The worktop is supported on U Shape Metal Legs 50mm x 50mm , powder coated under structure with Laminate Modesty panel. The Metal legs are connected by Metal Beams for stability and . The Table tops should have metal inserts on underside for modularity. The screw used should be blunt headed and not sharp headed for metal to metal coupling . Colour as per direction of Engineer in Charge. Side Storage unit is made of combination of hinged door unit and 3 Drawer unit - Storage body is made of 18mm thick pre laminated particle Board conforming to IS : 12823. The back of the unit is made from 18mm pre laminated board. All the exposed edges are with 2mm PVC edge Imported banding & sealed edges are with 0.8mm thick PVC Imported edge banding. The top, side and hinged shutters are sealed with 2mm thick PVC edge banding. Storage has adjustable shelves inside and cam lock, tower bolt and locking strips. The units are assembled by knock down fittings such as Minifix & Dowels.
18.1.11	Office Desk Table 1200mm width and 3 Drawer pedestal Unit	Office Desk Size: 1200 W x 600 D x 750 H mm. With Pedestal Supplying, and placing in position of office desk office desk structure of rectangular shape .Table top 25mm thick table top made of 25mm thick pre laminated particle board work surface with the exposed edges shall be finished with 2mm thick edge binding tape of matching colour and shade with the hot melt glue . modesty panel made of 18mm thick, wire management hole with

		<p>pvc grommet on table top. Construction right side of table top is based on a fixed pedestal 3 drawers & from left side of table top is based on 18mm thk engineered wood pvc edge banding pedestal back, top, bottom & drawers are made of 18mm thick with 1 cpu trolley made in black metal powder coated. Fixed pedestal: 410mm(l)x 580mm(d)x 750mm(h) ,in provided with central lock for security and handles are provided for easy of opening.</p> <p>overall construction of pedestal is 18 mm along with facia of drawers.</p> <p>three layer prelaminated particles board(wood product) of grade ii type iii of is 12823/ latest.</p>
18.1.12	Office Desk size 2400mm with side unit	<p>Office Desk</p> <p>Overall Size: 2400 W x 2200 L x 770 H mm.</p> <p>Supplying, and placing in position of table as per schedule. This precise Durian Boss's Desk is 50mm thick table top made of MDF board with natural veneer work surface with cherry finish veneer same matching veneer edge banding made of same dark cherry P.U. polish. Modesty is designed with leather patch. Side panel made of 40mm thick. Provision of side unit of size is 900mm(l)x 595mm(d)x 770mm(h), construction of side unit top made of 50mm thick, 1 fixed shelve with 1 sliding shutter. All the MDF board are IS-14587-1998 with confirm to din 68861. ISO 9001- 2015 quality certification confirming to ASTM d 4499 standards for viscosity and thermal stability.</p>
18.1.13	Coffee Table size 1200mm x 400mm x 485mm	<p>Coffee Table</p> <p>Size: 1200 W x 600 D x 485 H mm.</p> <p>Supplying and placing in position of Coffee Table in Two Tone Finish with open shelves.</p>
18.1.14	Modular Work station	<p>Workstation</p> <p>Supplying and placing in position of sliding tile base modular Workstation as per schedule/drawing. Free standing partition height 1200mm and should be minimum of 65-67mm thick. Partition inner frame is 1.1-1.2 mm thick mild steel. Horizontal and vertical trims are made out of extruded aluminium of 1mm thick. All Panels / trims shall be powder coated with 50 microns. Aluminium trims are elegantly fixed with special fixtures in the partition. The frame work shall be fitted with 9mm thick pre laminated Particle tiles of approved shade. Partition shall have provision for pin up board with fabric/ white marker/ laminated of approved shade. Partition framework shall have adequate provisions for the movement of electric data cables at desired 2 levels; one at skirting and another above / below the table top. The complete partitioning work shall be carried out as per the approved drawing. Table top for workstation made up of 25mm thick pre laminated Particle board of approved shade. The worktop shall be supported on minimum 2mm thick powder coated CRCA brackets and side panels. Side's panels should be made from 18mm thick pre laminated Particle board of approved shade. All working or non-working edges shall be provided with machine pressed 2mm thick PVC edging using special hot melt glue at hot temperature. one PVC keyboard tray and Metal CPU trolley with lockable castors for each seating. Also a provision of fixed Pedestal Unit (size:- L-400mm x D-450mm x H-725mm) with a combination of 2 drawer & one filing drawer. The pedestal storage unit shall be made of 18 mm thick prelaminated Particle board with provision of handles & central Locking arrangement.</p>

18.1.14.1		Workstation 65/5x5 Single Seater Linear Workstation Size: 1500 W x 1500 L x 600 D x 1200 H mm, With Drawer Pedestal
18.1.14.2		Workstation 65/2 Two Seater Linear Workstation Size: 2400 W x 600 D x 1200 H mm, With Drawer Pedestal
18.1.14.3		Workstation 65/3 Three Seater Linear Workstation Size: 3600 W x 600 D x 1200 H mm.
18.1.14.4		Workstation 65/4 Four Seater Linear Workstation Size: 4800 W x 600 D x 1200 H mm.
18.1.15	Meeting Table size 2380mm x 1100mm	Meeting Table Size: 2380 W x 1100 D x 750 H mm. Supplying, and placing in position of meeting table, table top offers you a generous workspace, desk primary work surface use premium quality materials table top made of 50mm thick which give more surface area for work, prelaminated particle board, table top supported with 75mm thick (6 mm + filler +6 mm) BSL steam beech veneer with sb-8 polish in brown-wenge colour on prelaminated particle board of grade ii type iii of IS 12823/latest. Construction below table modesty height @ 200 mm, 15mm thick BSL steam beech veneer with sb-8 polish. In between both the supporting panels length is @ 1480 mm, over all table height is @ 750 mm and the side panel size is 800 mm (l) x 700 mm(h). our work surface furniture is finished with exposed edges shall be finished with 2mm thick edge binding tape of matching colour and shade, fixed with hot melt glue.
18.1.16	Conference Table size 6000mm x 1200mm	Conference Table Size: 6000 W x 1200 D x 750 H mm. Supplying, and placing in position of conference room table, offers you a generous workspace, desk primary work surface use premium quality materials. Table top shall be made out of 25 mm thick prelaminated particle board of grade ii type iii of IS 12823/latest, construction provision the oval shaped conference table size is 1600mm (l) x 1200mm (d) x 750mm (h) and closed with the corners of tables of size 600mm (l) x 600mm (d) x 750mm (h).table top shall be made out of 25 mm thick prelaminated particle board and top based on side panel shall be made out of 18mm thick prelaminated particle board size is 400 mm(l) x 715 mm(h) and below the table top modesty panel shall be made 18mm thick prelaminated particle board size is 1559 mm(l) x 400 mm(h). Conference table extendable part comes in semicircle shaped size is 1200mm (l) x 600mm (d) x 750mm (h). extendable part top made out of 25mm thick in prelaminated particle board. Top based on centre panel shall be made out of 18mm thick prelaminated particle board size is 400 mm(l) x 715 mm(h) and below the extendable part top modesty panel shall be made 18mm thick prelaminated particle board size is 200 mm(l) x 400 mm(h) .when the extendable part and table fixed together supporting with 18mm thick prelaminated particle board box size is 209 mm(l) x 400 mm(h).our work surface furniture is finished with exposed edges shall be finished with 2mm thick edge binding tape of matching colour and shade, fixed with hot melt glue

18.1.17	2 Seater Sofa with Leatherite upholstery	2 Seater Sofa in Eerie Black Size: 1550 W x 865 D x 815 H mm. Material & Subtype: Premium Leatherite Upholstery Material: Premium Leatherite Seat Material: Premium Leatherite Finish: Matte Colour & Colour Family: Black / approved colour.
18.1.18	3 Seater Sofa with Leatherite upholstery	Premium Leatherite Sofa, 3 Seater Size: 2100 W x 865 D x 815 H mm. Material & Subtype: Premium Leatherite Upholstery Material: Premium Leatherite Seat Material: Premium Leatherite Finish: Matte Colour & Colour Family: Black - Eerie Black
18.1.19	Back Tall Unit	BACK TALL UNIT Size: 1300 W x 600 D mm
18.1.20	Working Counter	WORKING COUNTER Size: 1500 W x 750 D x 900 H mm.
18.2		NURSING STATIONS – CUSTOMISED as per GFC drawings / Schedule made from solid Acrylic surfaces top, front and sides
18.2.1	Nursing Table with side unit 2600mm long 900 wide	Table Size: 2600 W x 900 D x 750 H mm & 1050 mm, Side Unit Size: 1200 W x 600 D x 750 H mm. (with wash basin)
18.2.2	Nursing Table with side unit 2600mm long 600 wide	Table Size: 2600 W x 600 D x 750 H mm & 1050 MM., Side Unit Size: 1200 W x 600 D x 750 H mm. (with wash basin)
18.2.3	Nursing Table 1900mm long 600 wide	Table Size: 1900 W x 600 D x 750 H mm. (with wash basin)
18.2.4	Nursing Table 3300mm long 600 wide	Table Size: 3300 W x 600 D x 750 H mm & 1050 mm. (with wash basin)
18.2.5	Nursing Table 2700mm long 600 wide	Table Size: 2700 W x 600 D x 750 H mm. (with wash basin)
18.2.6	Nursing Table 7000mm long 750 mm wide	Table Size: 7000 W x 750 D x 750 H mm & 1050 MM. (with wash basin)
18.2.7	Command Center Table 2600mm wide with side unit 1300mm long	COMMAND CENTER Table Size: 2600 W x 600 D x 750 H mm & 1050 mm. Side Unit Size: 1300 W x 600 D x 750 H mm. Back Unit Size: 2600 W x 500 D x 750 H mm. (with wash basin)
18.2.8	Nursing Table 1500mm long 600 mm wide	Table Size: 1500 W x 600 D x 750 H mm.

	Locations	FURNITURE FOR MICROSCOPY LAB / ELECTRICAL & ELECTRONIC CHARACTERIZATION LAB / MECHANICAL CHARACTERIZATION LAB / ADVANCE ELECTRONICS LAB / MATERIAL CHARACTERIZATION LAB / INCUBATOR BIONEST / DESIGN LAB / RECEPTION / HOD ROOM / FACULTY ROOM / CONFERENCE ROOM / LECTURE HALL / CLASS ROOM / STILT (OPEN CAFE)- ACADEMIC & R&D BLOCK
S.No.	Item	Short Description of item
18.3.1	Reception Desk	Supplying Reception desk 2400mm wide, 900mm deep, 750mm / 1100 mm height with 3 drawer mobile pedestal drawer, minimum 400mm wide 450mm deep and 720mm high, complete as per GFC drawings / Image.
18.3.2	Medium Back chairs	Supplying Standard Medium Back Mesh Chair of size 585mm Width x 660mm Depth x 1060mm height, Seat depth: 500mm, Back Height: 490mm, 360°-degree revolving chair , made of full mesh in black colour or approved colour, nylon structure with nylon net on back, fixed pp armrest, 12 mm thick hot pressed BWR plywood (IS grade - 303 for seat), Seat having 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cum cushioning in seat, Back made of two pieces injection moulded frame cover with mesh. backrest support adjustable lumbar support, single locking mechanism, Gas lift 100 mm telescopic hydraulic, 650mm nylon base with smooth castors.
18.3.3	Work stations with free standing aluminium partitions,	Supplying and installation of Sliding tile base modular Workstation as per schedule / drawing with free standing partition height 1200mm and should be minimum of 65-67mm thick. Partition inner frame is 1.1-1.2 mm thick mild steel. Horizontal and vertical trims are made out of extruded aluminium of 1 mm thick. All Panels / trims shall be powder coated with 50 microns. Aluminium trims are elegantly fixed with special fixtures in the partition. The frame work shall be fitted with 9mm thick pre laminated Particle tiles of approved shade. Partition shall have provision for pin up board with fabric / white marker/ laminated of approved shade. Partition framework shall have adequate provisions for the movement of electric data cables at desired 2 levels; one at skirting and another above / below the table top. The complete partitioning work shall be carried out as per the approved drawing. Table top for workstation made up of 25mm thick pre laminated Particle board of approved shade. The worktop shall be supported on minimum 2mm thick powder coated CRCA brackets and side panels. Side's panels should be made from 18mm thick pre laminated Particle board of approved shade. All working or non-working edges shall be provided with machine pressed 2mm thick PVC edging using special hot melt glue at hot temperature.
18.3.4	Work stations	Single Seater Linear Workstation Size: 1200W x 600D x 1200H mm.
18.3.5	work stations	Two Seater Linear Workstation Size: 2400 W x 600 D x 1200H mm.
18.3.6	work stations	Four Seater Linear Workstation Size: 4800 W x 600 D x 1200 H mm.
18.3.7	work stations	Four Seater Linear Workstation (back to back) Size: 2400 W x 1200 D x 1200 H mm.

18.3.8	work stations	Four Seater Linear Workstation Size: 1800 W x 1200 D x 1200 H mm.
18.3.9	work stations	Four Seater Linear Workstation Size: 3600 W x 1200 D x 1200 H mm.
18.3.9	Key Board	Supplying and fixing PVC Key board tray for all works stations – 1no
18.3.10	Metal CPU trolley with lockable castors	Supplying Metal CPU trolley with lockable castors for each seating.
18.3.11	Pedestal Unit for all work stations	Supplying Fixed Pedestal Unit, size 400mm wide x 450mm deep x 725mm height) with a combination of 2 drawer & one filing drawer. The pedestal storage unit shall be made of 18 mm thick prelaminated Particle board with provision of handles & central Locking arrangement.
18.4	Table with side unit	Supplying Table with side unit, table Size: 1500 W x 750D x 750H mm, Side Unit Size: 1050 W x 450D x 750H mm. Supplying and placing in position of table top shall be made of 25mm thick pre- Laminated particle board of approved shade. Table Top working edges shall be provided with matching machine pressed 2mm thick PVC edging using with special hot melt glue at hot temperature. Table top supported on side panels and modesty panel. Side and Modesty panel shall be made out of 18mm thick pre-laminated particle board laminated on both sides as approved shade. The working or nonworking edges shall be provided with matching machine pressed 2mm thick PVC edging using with special hot melt glue at hot temperature. The table shall be provisioned with side unit top shall be made of 25mm thick prelaminated particle board matching with table top. Side unit backing shall be 9mm thick pre-laminated. Side unit having two sliding shutters and a shelf inside with handles and locking arrangements.
18.4.1	High Back chairs	Supplying High Back Mesh Chair - Dimension: 640 W x 670 D x 1350H mm. Seating Height: 540mm, Seat depth: 500mm, Back Height: 815mm high back 360°-degree revolving chair. chair made of full mesh in black or approved colour, Armrest is having two adjustment heights (up & down), 12 mm thick hot pressed BWR plywood (IS grade - 303 for seat), 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cum in seat, Back frame of design shall be curved made of two pieces injection moulded frame cover with mesh, backrest support adjustable lumbar support, self-weighted multi locking mechanism, seat size is 500mm (wide) x 500mm (depth) x 540-440mm (height) & the back size is 480mm (width) x 815mm(height), seat maximum height is 540mm & minimum height is 440mm & back height from floor maximum height is 1350mm & minimum height is 1250mm. Gas lift 100 mm telescopic hydraulic with 650 mm chrome prong base is 620mm pitch centre Dia (660mm with castors).
18.4.2	Two seater sofa	Supplying and placing position Premium Leatherite 2 Seater Sofa, Size: 1550mm With x 865mm Depth x 815mm Height.
18.4.3	Single seater sofa	Supplying and placing position Premium Leatherite 1 Seater Size: 1040mm With x 865mm Depth x 815mm Height

18.4.4	Coffee Table	<p>Supplying Solid Wood Coffee Table, Size: 1130mm Width x 630mm Depth x 410mm height mm, with tapered legs, Crafted with solid beech wood, the dark oak finish accentuates the distinctive wood grains. The glass table top is made with sturdy glass, beautifully bordered by a solid wood frame.</p>																		
18.4.5	Office table and side unit	<p>Supplying Office Desk Table Size: 1500mm Width x 750mm width x 750mm Height & Side Unit Size: 1050mm wide x 450mm Depth x 750 Height The Main Table is made of 25mm thick Prelaminated particle board with 2 mm thick PVC Lipping on the edges. The worktop is supported on U Shape Metal Legs 50mm x 50mm, powder coated under structure with Laminate Modesty panel. The Metal legs are connected by Metal Beams for stability. The Table tops should have metal inserts on underside for modularity. The screw used should be blunt headed and not sharp headed for metal to metal coupling . Colour as per direction of Engineer in Charge. Side Storage unit is made of combination of hinged door unit and 3 Drawer unit - Storage body is made of 18mm thick pre laminated particle Board conforming to IS : 12823. The back of the unit is made from 18mm prelaminated board. All the exposed edges are with 2mm PVC edge Imported banding & sealed edges are with 0.8mm thick PVC Imported edge banding. The top, side and hinged shutters are sealed with 2mm thick PVC edge banding. Storage has adjustable shelves inside and cam lock, tower bolt and locking strips. The units are assembled by knock down fittings such as Minifix & Dowels.</p>																		
18.4.6	Medium Back chairs fixed base type	<p>Supplying Medium Back Mesh Chair, Dimension: 605mm Width x 575mm Depth x 1010 Height, Seating Height: 470mm, Seat depth: 500mm, Back Height: 550mm, Fixed cantilever chair, full mesh in black or approved colour, PP fixed padded armrest, 12 mm thick hot pressed BWR plywood (IS grade - 303 for seat), 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cum in seat, frame of design shall be curved made of two pieces injection moulded frame cover with mesh, backrest support adjustable lumbar support, seat size is 500mm (wide) x 500mm (depth) x 470mm (height) & the back size 465mm (wide) x 550mm(height), seat max height is @ 470mm, Base - MS powder coated tubular frame of cantilever type.</p>																		
18.4.7		<table border="0"> <tr> <td>Premium</td> <td>Leatherite</td> <td>Sofa,</td> </tr> <tr> <td>Material</td> <td>& Subtype:</td> <td>Premium Leatherite</td> </tr> <tr> <td>Upholstery</td> <td>Material:</td> <td>Premium Leatherite</td> </tr> <tr> <td>Seat</td> <td>Material:</td> <td>Premium Leatherite</td> </tr> <tr> <td>Finish:</td> <td></td> <td>Matte</td> </tr> <tr> <td colspan="3">Colour & Colour Family: Black or as approved</td> </tr> </table>	Premium	Leatherite	Sofa,	Material	& Subtype:	Premium Leatherite	Upholstery	Material:	Premium Leatherite	Seat	Material:	Premium Leatherite	Finish:		Matte	Colour & Colour Family: Black or as approved		
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Finish:		Matte																		
Colour & Colour Family: Black or as approved																				

18.4.8	Four seater meeting table	Supplying four-seater modern design meeting table 900 W x 900D x 750 H mm a combination of metal and wood make the products utile and a delight. Timeless design that elevates your office space structure of spacious meeting table, table top made of 25 mm thick which give work surface furniture is finished with exposed edges shall be finished with 2mm thick edge binding tape of matching colour and shade, fixed with hot melt glue on prelaminated particle board of grade ii type iii of IS 12823/latest,Table top based on stylish chrome plated led. In middle of table top power box cut-out to access switches + data ports, up box on above table top with single metal MS powder coated to the thickness 50-60 microns (+/-5 micron) raceway for wiring and table top based on stylish chrome plated led.
18.4.9	Stackable cafeteria chairs	Supplying cafeteria chair size is 381mm(l)x 419mm(d)x 839mm(h), combination of synthetic fiber with stainless steel, the complete structure shall be made up of 20% glass filled blow moulded high-density polyethylene and is site frame structure shall be supported by (2 straight + 2 slant) four legs. The tubular welded frame is made from dia 2.22 +/- 0.03cmx 0.12+/- 0.0128 cm and 3.5+/- 0.03 cm x 0.12+/- 0.0128 am stainless steel 202 grade tube & the tube are buff polished to give shiny finish. Seat and in back given handle to hold are made of injection moulded high impact strength polypropylene polymer compound with indoor grade UV resistance and pressed fitted with legs.
18.4.10	Meeting table 2400mm long	Supplying, and placing in position of meeting table Size: 2380W x 1100 D x750 H mm , premium quality materials table top made of 50mm thick which give more surface area for work, prelaminated particle board, table top supported with 75mm thick (6 mm + filler +6 mm) BSL steam beech veneer with sb-8 polish in brown-wenge colour on prelaminated particle board of grade ii type iii of IS 12823/latest. Construction below table modesty height @ 200 mm, 15mm thick BSL steam beech veneer with sb-8 polish. In between both the supporting panels length is @ 1480 mm, over all table height is @ 750 mm and the side panel size is 800 mm (l) x 700 mm(h). Work surface furniture is finished with exposed edges shall be finished with 2mm thick edge binding tape of matching colour and shade, fixed with hot melt glue.
18.4.11	Meeting table 3600mm long	Supplying, and placing in position of meeting table Size: 3600Wx1100Dx750H mm , table top use premium quality materials table top made of 50mm thick which give more surface area for work, prelaminated particle board, table top supported with 75mm thick (6 mm + filler +6 mm) BSL steam beech veneer with sb-8 polish in brown-wenge colour on prelaminated particle board of grade ii type iii of IS 12823/latest. Construction below table modesty height @ 200 mm,15mm thick BSL steam beech veneer with sb-8 polish. In between both the supporting panels length is @ 1480 mm, over all table height is @ 750 mm and the side panel size is 800 mm (l) x 700 mm(h). Work surface furniture is finished with exposed edges shall be finished with 2mm thick edge binding tape of matching colour and shade, fixed with hot melt glue.

18.4.12	Free Standing table	<p>Supplying Free Standing Table , Size: 1500W x 500D x 750 H mm, made from 25mm thick Prelaminated particle Board with PVC edge banding. Table top supported with Powder coated "C" shape metal legs of size 50mm x 50mm and connectors of size 40mm x 40mm, Providing 18mm thick prelaminate particle board modesty panel at front side, below top.</p>
18.4.13	Table top	<p>Table Top: The width of the table should be 450mm and maximum length shall be 550mm measured along the curved inner edge (sitting side) of the table. The top of the table should be made of 18mm thick BWP plywood laminated with 1mm thick scratch resistant laminate pasted on one side (top surface) and shall have four side framing with white ash wood section of size 55x28 mm moulded uniformly and slightly chamfered (0.5 to 1mm) with no joints to be seen. No intermediate partition should be there in a row. There should not be any side panel at the end of each row. The table should be supported by a cantilever MS under structure. Inner surface of modesty and bottom of table top shall be provided with balancing laminate of minimum 0.8mm thick matching with table top laminate of approved shades. Modesty Panel: The modesty panel shall be made from 12mm thick one side (front side) white ash veneered MR grade plywood and shall have four side framing of white ash wood section 55x28mm. The top edge of the modesty panel shall be provided with a groove of size 4mm (wide)x20mm(deep) running continuously along the length of the table. The groove shall hold SS name plates. The gap between the Modesty panel and finish floor level should not be more than 150mm. MS Under structure: The table legs shall be made from 75mm dia x 2 mm thick MS pipe having 120mm dia x 4mm thick MS base plate welded to the legs. Foot rest shall be made from 40mm dia x 2 mm thick MS pipe running along the length of the table. The table top shall have additional under supports made from 25mm square x 2 mm thick MS pipe which shall be welded to each leg. The distance between the legs /supports shall not be more than 835 mm. However the quantity of legs / supports for each table shall vary as per seating capacity and length of the table, refer indicative drawing provided. All MS structure shall be powder coated to the thickness of 40-50 microns as per colour to be approved by the Institute. All ends of frame shall be smoothly polished and plugged with plastic moulded end cap. Fixing: The table shall be fixed on a cement concrete floor with help of four anchor fastener of length not less than 100mm of appropriate thickness on each leg base plate grouted to the floor. Finishing: Low SVHC Water Based polish which conforms to REACH Regulations shall be used. All wood and veneer surface to be sanded smooth and surface to be prepared with fillers and water based sealers. 04 coats of premium water-based topcoat in satin finish to be applied for a smooth and protective finish.</p>

		<p>Construction and joinery: The curvilinear shape of the table shall be made to follow the curvature of the tread in each classroom. All wood and plywood panels shall be joined together using tongue and groove joinery along with good quality water resistant wood adhesives. All metal and wood parts shall be joined together with SS screws of required size. Good quality kiln dried (permissible moisture content not more than 10%) white ash wood shall be used. BWP and MR grade plywood, white ash veneer and 1mm laminate from the list of approved makes shall be used.</p> <p>Wire Management System: The Grommet shall be made from antiskid plastic moulded components to facilitate access electrical / data / voice sockets access from top. Vertical cable separately from bottom of table along with raceway having cut outs of required sizes along with SS Hydraulic Pop Up Box / Cable Cubby with Audio, Power Ports and USB C type Port. The hydraulic pop up box should be made of stainless steel. The minimum size of the Panel: 264 X 117 mm Hole Size: 222mm 108mm X 65 mm Wooden Cutting Board Size: 227 x 105 MM. The silvery top cover shall be made of aluminium alloy, rustproof, weatherproof, waterproof gasket with IP44 waterproof rating, UL certified, tamper-proof export, the bottom box is made of stainless steel, black paint, to play the role of antioxidant coating. One Pop up box to be provided for two students.</p>
18.4.14	Podium top & side panels	<p>Providing & supplying vintage podium top & side panels Size: 550 W x 550 D x 1200 H mm, made in 18mm thick prelaminated particle board of grade ii type iii of IS 12823/latest with machine pressed exposed edges shall be finished with 2mm thick edge binding tape of matching colour and shade fixed duly pasted with the assistance of edge banding machine at 200 degrees Celsius. The podium houses a flat table top to keep notes handy while allowing for wiring and a stand for mic. Three layer prelaminated particles board (wood product) of grade ii type iii of IS 12823/latest.</p>
18.4.15	Low Back chairs	<p>Supplying Low Back Fabric Chair, Dimension: 490 W x 360 D x 820H mm, Seating Height: 480mm, Seat depth: 360mm, Back Height: 360mm, designed with movable writing pad and storage tray. The premium soft fabric wraps its streamlined profile for a comfortable seating experience during training sessions or waiting hours. The chair made of full fabric in black colour, Arms: fixed armrests with half writing pad, 12 mm thick hot pressed BWR plywood (IS grade - 303 for seat and back), 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cum, Back: 40 ± 2 mm thick polyurethane foam with density 32 (±3) kg per cum cushioning in back, backrest support foam design based on symmetrical lumbar support, seat size is 490mm (l) x 360 mm (d) x 480mm (h) & the back size is 400mm (l) x 360 mm (h), seat height is @ 480mm. Base: 4 legs metal powder coated frame with paper tray</p>

18.5		SCOPE OF WORK, SCHEDULE OF ITEMS, PARTICULAR SPECIFICATIONS FOR FURNITURE – NURSES HOSTEL as per GFC drawings / schedule
S.no.	Item	Short Description of item
18.5.1	Reception table for reception & waiting area	Reception Table size 1800mm x 600mm and 750/1050mm high with 3 drawer mobile pedestal unit, wire management system
18.5.2	Low height Modular storages 750mm high	Low height Modular storages 1200mm x 450mm x 750mm high made from 18mm thick prelaminated board and 25mm top board as/per details.
18.5.3	2 seater sofa for reception	2 seater sofa fabric upholstered with wooden leg, 1350mm long, having PU foam seats and back complete 3
18.5.4	Centre table for reception	Centre table size 1200mm x 600mm x 425mm made from melamine finish first class wood complete
18.5.5	Side table for reception	Side table size 450mm x 450mm x 425 mm made from melamine finish first class wood complete
18.5.6	Medium back chair for reception	Medium back revolving chair , seat upholstered with fabric 300 GSM thick, moulded PU foam seat and back with mesh tapestry, centre tilt revolving mechanism, injection moulded 650mm dia base with 5 no nylon castors complete
18.5.7	Single bed for nurses -	Single bed without box size 900mm wide x 1800mm long and 400mm high made from best quality prelaminated board with head side board, bed seat made of 12mm thick BWP plywood with support frame complete without mattresses and pillows
18.5.8	Chairs	Chairs without castors , chair seat and back made from 12mm thick hot pressed plywood, cushioned with 45mm thick moulded foam of density 40-45 kg per cum, chrome frame, upholstered with Leatherite complete
18.5.9	Bed side table	Bed side table modular size 450mm x 450mm x 450mm with drawers complete
18.5.10	Wardrobe for Nurses size 750mm wide, 600mm deep and 1800mm high	Modular Wardrobe for Nurses size 750mm wide, 600mm deep and 1800mm high, carcass, shelves and shutter made from 18mm thick prelaminated particle board, 2mm PBV edge banding, hanger rod, spring loaded hinges, SS handles and cupboard lock complete
18.5.11	Wardrobe for Nurses size 900mm wide, 600mm deep and 1800mm high	Modular Wardrobe for Nurses size 900mm wide, 600mm deep and 1800mm high, carcass, shelves and shutter made from 18mm thick prelaminated particle board, 2mm PBV edge banding, hanger rod, spring loaded hinges, SS handles and cupboard lock complete
18.5.12	Wardrobe for Nurses size 1000mm wide, 600mm deep and 1800mm high	Modular Wardrobe for Nurses size 1000mm wide, 600mm deep and 1800mm high, carcass, shelves and shutter made from 18mm thick prelaminated particle board, 2mm PBV edge banding, hanger rod, spring loaded hinges, SS handles and cupboard lock complete
18.5.13	Wardrobe for Nurses size 1200mm wide, 600mm deep and 1800mm high	Modular Wardrobe for Nurses size 1200mm wide, 600mm deep and 1800mm high, carcass, shelves and shutter made from 18mm thick prelaminated particle board, 2mm PBV edge banding, hanger rod, spring loaded hinges, SS handles and cupboard lock complete
18.5.14	Study tables	Study tables size 1000mm wide x 600mm deep and 750mm high made

		from 25mm thick prelaminated particle board and 18mm thick gable ends and modesty panel, all exposed edges sealed with 2mm thick pvc edge banding, 1 no pencil drawer, 1 PVC wire manager , complete.
18.5.15	Study chairs	Study chairs ergonomically designed, seat made of 12mm thick moulded plywood with PU foam seat density 48 kg/cum, with fabric upholstery 300 GSM, polypropylene back, MS chrome base of 25.4mm dia pipe complete.
18.6	Item	SCOPE OF WORK, SCHEDULE OF ITEMS, PARTICULAR SPECIFICATIONS FOR FURNITURE – RESIDENT HOSTEL CUM GUEST HOUSE as per GFC drawings / schedule
18.6.1	Reception table for reception & waiting area	Reception Table size 1800mm x 600mm and 750/1050mm high with 3 drawer mobile pedestal unit, wire management system
18.6.2	Low height Modular storages 750mm high	Low height Modular storages 1050mm x 450mm x 750mm high made from 18mm thick prelaminated board and 25mm top board as/per details.
18.6.3	2 seater sofa for reception	2 seater sofa fabric upholstered with wooden leg, 1350mm long, having PU foam seats and back complete
18.6.4	1 seater sofa for reception	2 seater sofa fabric upholstered with wooden leg, 850mm long, having PU foam seats and back complete
18.6.5	Centre table for reception	Centre table size 1200mm x 600mm x 425mm made from melamine finish first class wood complete
18.6.6	Side table for reception	Side table size 450mm x 450mm x 425 mm made from melamine finish first class wood complete
18.6.7	Medium back chair for reception	Medium back revolving chair , seat upholstered with fabric 300 GSM thick, moulded PU foam seat and back with mesh tapestry, centre tilt revolving mechanism, injection moulded 650mm dia base with 5 no nylon castors complete
18.6.8	Single bed for residents	Single bed without box size 900mm wide x 1800mm long and 400mm high made from best quality prelaminated board with head side board, bed seat made of 12mm thick BWP plywood with support frame complete without mattresses and pillows
18.6.9	Bed side table	Bed side table modular size 450mm x 450mm x 450mm with drawers complete
18.6.10	Wardrobe for Residents size 750mm wide, 600mm deep and 1800mm high	Modular Wardrobe for Nurses size 750mm wide, 600mm deep and 1800mm high, carcass, shelves and shutter made from 18mm thick prelaminated particle board, 2mm PBV edge banding, hanger rod, spring loaded hinges, SS handles and cupboard lock complete.
18.6.11	Study tables	Study tables size 1000mm wide x 600mm deep and 750mm high made from 25mm thick prelaminated particle board and 18mm thick gable ends and modesty panel, all exposed edges sealed with 2mm thick pvc edge banding, 1 no pencil drawer, 1 PVC wire manager , complete.
18.6.12	Study chairs	Study chairs ergonomically designed, seat made of 12mm thick moulded plywood with PU foam seat density 48 kg/cum, with fabric upholstery 300 GSM, polypropylene back, MS chrome base of 25.4mm dia pipe complete.
18.6.13	Double bed for Guests	Double bed without box size 2000mm wide x 2170mm long and 400mm high, head board 1000mm made from best quality solid wood with head side board duly melamine polished, bed seat made of 12mm thick BWP plywood with support frame complete without mattresses and pillows

18.6.14	Bed side table for guests - 2 no for each double bed	Bed side table modular size 450mm x 450mm x 450mm with drawers complete
18.6.15	Study tables for guest rooms- 56 no	Study tables size 900mm wide x 600mm deep and 750mm high made from 25mm thick prelaminated particle board and 18mm thick gable ends and modesty panel, all exposed edges sealed with 2mm thick pvc edge banding, 1 no pencil drawer, 1 PVC wire manager , complete.
18.6.16	Study chairs for guest rooms- 56 no	Study chairs ergonomically designed, seat made of 12mm thick moulded plywood with PU foam seat density 48 kg/cum, with fabric upholstery 300 GSM, polypropylene back, MS chrome base of 25.4mm dia pipe complete.
18.6.17	TV unit for guest rooms	TV Unit size 1600 mm long, 450mm deep and 450mm high made out of 18mm thick prelaminated board, having shelves, edges sealed with 2mm thick PVC hot pressed of colour as sample approved.
18.6.18	Wardrobe for Guest rooms size 750mm wide, 600mm deep and 1800mm high 2 no in each,	Modular Wardrobe for Nurses size 750mm wide, 600mm deep and 1800mm high, carcass, shelves and shutter made from 18mm thick prelaminated particle board, 2mm PBV edge banding, hanger rod, spring loaded hinges, SS handles and cupboard lock complete

Note : The schedule of items mentioned above are indicative and not exhaustive, Any item not stated under this section but shown in the GFC drawings / Particular specifications shall deemed to be included under the scope of this item.

LIST OF APPROVED MAKES

LIST OF APPROVED / PREFERRED MAKES

	The contractor shall submit at least 03 makes from the approved list of makes or equivalent makes of the item for approval of the Engineer In Charge. Wherever makes of items are not specified, approval of Engineer-In-charge shall be obtained. Generally sample shall be approved from these 03 makes. The Tenderer shall quote his rates on the basis of the price of quality and grade of product of the brand/make stipulated in the item of works as described in BOQ & Specification as well as in the list of approved make. However, the contractor cannot claim anything extra if the Engineer -in Charge /Owner selects any other make from the list of approved makes.			
Sl. No.	Material / Items	Approved Makes / Brands / Manufacturer / Agency		
	1. CIVIL, ARCHITECTURAL & STRUCTURAL			
1	Ordinary Portland Cement / Portland Pozzolona Cement	ACC	Ultratech	J. K Cement
		Dalmia	Lafarge	Birla
2	White Cement	Birla White	J.K. White	Ultratech
3	Ready-mix Concrete	Manufacturer of RMC subject to approval of Engineer-in-charge. The contractor shall submit the RMC plant list for approval.		
4	Reinforcement Steel (HYSD TMT)/	SAIL	Tata Steel (Tiscon)	RINL
		JSW Steel Ltd	JINDAL STEEL & POWER LTD	
5	Structural Steel / M.S. Tubes	SAIL	Tata Steel	RINL
		JSW Steel Ltd	Jindal Steel	APL Apollo
6	Parallel Threaded Couplers	Dextra	Usha Martin	G-Tech splicing
		TATA		
7	Anchoring Fasteners	Hilti	Fisher	Bosch
		Canon		
8	High performance epoxy based Resin Anchor system	Hilti	BASF	FOSROC
9	AAC Block	Biltech	Magicrete	JK Lakshmi
		Shree Cement	Brikolite	Green Block
		Indo Bhutan	Ultratech xtralite	Aerocon
		Jindal Block	Modcrete	Fincrete
		ULTRALYTE	SUPERLITE	
11	Expansion Joint Treatment-	C.S.	Herculus	Z-Tech

	Modular	Vexcolt	Devin	Sainfield
		BASF	MIGUA (Cameo INC)	TECHNOCRATS
		Tristar	Genotech	Inprocorp
12	Plasticizer, Super Plasticizer, Admixtures, Other construction chemicals	BASF	Fosroc	Pidilite
		MYK LATICRETE		
13	Corten steel sheet	Tenso Bengaluru	Vijay Nath	Nova steel corp.
14	Polycarbonate Sheet	GE Plastic (SABIC)	Gallina Poly	Lexan
		Tuflite	Polygal	Danpalon
15	Decking metal Sheet	TATA Blue scope	Lloyds	JSW
		KINGSPAN JINDAL		
16	Bitumen	Indian Oil	Bharat petroleum	Hindustan Petroleum
17	Rebaring Chemical	Hilti	3M India	Birla
18	Extruded Polystyrene Board	STP	Supreme	Ownes Corning
		Shalimar		
19	Curing Compound	Fosroc	Pidilite	BASF
		Kerakoll	MYK LATICRETE	
20	Stainless Steel	Salem Steel	Jindal Alloys / Steel	SAIL
		TATA Steel		
21	Welding Electrodes	Advani	Oerlikon	Modi
		L &T		
22	Standing Seam roofing system (Aluminium / Metal)	Kingspan Jindal	Tata Blue Scope	Kalzip
		Jindal Metlac		
23	Chemical Emulsion for Anti Termite Treatment (Chlorpyriphos Emulsifiable Concentrate)	a) Central In secticide Board approved chemical		
		b) Specialized agency should be member of IPCA, Pest Control of India		

24	PVDF coated Polyester Type Tensile fabric	Serge Ferrari	Mehgies FR	Mehlar
25	G.I. wire rope	Usha martin Nirmal Wires	Bharat Wire rope Wellworth	Asahi Ropes
26	Insulation XPS Boards	Fire stone Texsa System	Insuboard ARKC	Owens-Corning
2. WATERPROOFING MATERIALS				
28	Swellable Bar	Pidilite	Fosroc	BASF
29	Waterproofing Chemical Compound (Crystalline)	MYK LATICRETE Xypex Chemicals	Fosroc Krytone	Pidilite BASF
30	Bitumen membrane for waterproofing	Pidilite (Dr. Fixit) MYK LATICRETE	Grace STP	BASF Kunal Chemicals
31	Waterproofing Self Adhesive (HDPE) membrane	Pidilite (Dr. Fixit) MYK LATICRETE	Grace DBS	BASF Kerakoll
32	PU Elastomeric Membrane (spray applied for Deck Waterproofing)	Pidilite (Dr. Fixit) MYK LATICRETE	Grace DBS	BASF Kerakoll
33	Polysulphide Sealant	Fosroc MYK Laticrete GE	Pidilite Wacker BASF	 Dow Corning FAIRMATE
34	EPDM Waterproofing Membrane	Berger Carlisle	Pidilite DBS Firestone	STP MYK Laticrete
35	Silicone / Weather Sealant	Pidilite Wacker	Dow Corning	GE Plastics
3. FLOORING FINISHING				
36	Mosaic / Chequered Tiles	Bisazza	NITCO	Unitile

			Unistone	
37	Vitrified Tiles (Antiskid / Matt / Glazed)	Somany	Kajaria	H&R Johnson
		Asian (AGL)	RAK	NITCO
38	Concrete Paver Block & Kerb Stone	NITCO	Unitile	Ultra
		Pavitt	Unistone	
39	Ceramic Tiles / Glazed Tiles	Kajaria	Somany	H&R Johnson
		Asian (AGL)	RAK	NITCO
40	PVC Flooring	Armstrong	Tarkett	LG
		Wonder floor	Responsive	GERFLOOR
41	Cement Concrete Tiles incl. Designer Tiles	Unistone	Ultra	Eurocon
		Terra Firma	Pavitt	
42	Laminated Floor	BVG	Berry	Pergo
		Tarket	Greenlam	
43	Composite Marble / Engineered Stone	Asian	Johnson	Kalinga
44	Tile / Stone Adhesive	Pidilite	Ferrouscrete	MYK Laticrete
		Ardex Endura	Kerakoll	Weber
		Fosroc	BASF	
45	Epoxy Grout for tiles / stone	Pidilite	Ferrouscrete	MYK Laticrete
		Ardex Endura	Kerakoll	Weber
		Fosroc	BASF	
46	Self-Levelling Compound	ARDEX Endura	FOSROC	KERAKOLL
		DR. FIXIT		STP
47	Floor Hardener	Ironite	Fosroc	Hardonite
			Pidilite	
		BASF		Kerakoll
48	Laminated HDF flooring	BVG	PERGO	BERRY
		TARKET	Responsive	
54	Acrylic Solid Surfaces	Dupont	L.G-Himac	Samsung - Staron
		Hanex - Merino		
55	Epoxy Flooring / Epoxy Grouting Compound / Stone Sealer	Asian Paints	BASF	FOSROC
		Berger		STP
	4. FALSE CEILINGS			
56	False Ceiling – Gypsum	Saint Gobain	India Gypsum	USG Boral
		Armstrong		

57	False Ceiling – Metal	Saint Gobain	Hunter Douglas	Armstrong
		Gyptech Systems	Durlum	Harson Green
58	Gypsum Board	Saint Gobain (Gyproc)	USG Boral	Lafarge
		India Gypsum		
59	Open Cell Ceiling	Armstrong	India Gypsum	Hunter Douglas
		Gyptech Systems	Harson Green	Knauf
60	False Ceiling Grid / Acoustic tile System materials	Gyproc	Armstrong	USG Boral
		Grid System	Gridline	Gyptech Systems
61	Baffle Ceiling	Hunter Douglas	Armstrong	Gyptech Systems
		Durlum	Harson Green	Knauf
62	Calcium Silicate Tile Ceiling with grid	Gyproc	Boral	Hilux
		Aerolite	Gyptech Systems	
63	Heat Resistant Roof Tiles	Kajaria	Thermatek	Johnson India
		Nitco	varmore	Pavitt
64	Perforated Acoustical Wooden Ceiling & Perforated wooden slats	Ideatec	Topakustic	Fantoni
		Gyptech Systems	Tikitar Danosa	Himalayan
65	Glass fibre ceiling tiles	Armstrong	SAINT GOBAIN Echophon	Anutone
		Gyptech Systems		
66	Calcium Silicate Board False Ceiling	Everest	NCL	Aerolite
		Ultralite	USG Boral	
5. FACADE				
67	Reflective Glass	Saint-Gobain / Guardian / Sisecam /Asahi		
68	Clear Float Glass	Saint-Gobain / Sisecam /Asahi		
69	Fire Rated Glass	Saint-Gobain / Schott / Pyroguard		
71	Weather Sealant	Dow Corning / Sika / Momentive (GE Sealants)		
72	Structural Sealant	Dow Corning / Sika / Momentive (GE Sealants)		
73	Aluminium Composite Panel	Alpolic / Alucobond / Alubond / Viva		
74	Solid Aluminium Sheet	Aluform / Novelis / Hindalco		
75	Anchor Fastener's	Hilti / Fischer / Klimas		

76	Anchor Cast in Channels	Halfen / Hilti / Jordahl
77	EPDM & Silicon Gasket	Hanu / Bohra/ Alps /Amee Rubber / Osaka
78	Powder Coating	Jotun / AkzoNobel / Pulver
79	PVDF Coating	Valspar / PPG / AkzoNobel
80	Powder & PVDF Processer	SP Coating / Radiant Jaipur / Metal coaters
81	Spacer Tape (Open PU Cell)	Norton / Pentagon BOW / Hanu
82	Glass wool (Insulation)	UP Twiga / Rockwool India /
83	Fire Stop	Siderise / Hilti / Fischer
84	Smoke Seal Intumescent	Dow Corning / Hilti / Sika / Momentive
85	Spider	Dorma / Lisus / Kin long
86	Patch Fitting	Dorma / Geze / Kin long
87	Automatic Sliding doors	Portalp / Dorma / Geze
88	Revolving Doors	Dorma / Portalp /Record
89	SS Clamps / Undercut (Stone cladding)	Hilti / ACT / Keil / Blick
90	Mild steel	Jindal / Sail / TATA
91	Stainless Steel	Salem Steel / TATA / Jindal
92	Aluminium Extrusion	Jindal / Sapa / Bhoruka / Hindalco / Global
93	Anodizing	Dow Chemicals
94	Sintered stone panels/ Porcelain Panels	Laminam / Nexion / Neolith/ LIOLI/ STONELAM
95	Accessories (Façade)	
96	SS Friction Hinges	Giesse / Cotswold (UK) / Securistyle / System supplied/Godrej/IPSA/Ozone
97	Multipoint Locking sets	Giesse / Lavaal / Alualpha / System supplied/ Godrej/IPSA/Ozone
98	Handle	Giesse / Lavaal / Alualpha / System supplied/ Godrej/IPSA/Ozone
99	Rollers for Sliding's	Giesse / Lavaal / Alualpha / System supplied/ Godrej/IPSA/Ozone
99.1	Flush lock for Sliding's	Giesse / Lavaal / Alualpha / System supplied/ Godrej/IPSA/Ozone
99.2	Wool Pile with Silent Film	Schlegel / System supplied/ Godrej/IPSA/Ozone
99.3	Windows Hinges	Giesse / Lavaal / Alualpha / System supplied/ Godrej/IPSA/Ozone
99.4	Doors Hinges	Giesse / Lavaal / Dr Hahn / Alualpha / System supplied/ Godrej/IPSA/Ozone

7. GYPSUM, PUTTY, PAINTS, POLISH

100	Gypsum Plaster	USG Boral	Asian	Ultratech
		Ferrouscrete	JK Laxmi	Gyproc
101	Oil Bound Washable Distemper / Acrylic	Ultratech	AkzoNobel (Dulux)	Berger

	Distemper	Nerolac (acrylic)	Asian Paints (Tractor Acrylic)	Dulux
102	Premium Acrylic / plastic Emulsion Paints	AkzoNobel (Dulux)	Nerolac I impression 24)	Asian Paints (Royal shine)
		Berger (silk luxury)	Ultratech	
103	Water Proof Cement paint	Snowcem Plus	Berger(Durocem Extra)	Nerolac (Nerocem with Titanium)
		Asian	ICI	Sika
104	Steel / Wood Primer	AkzoNobel	Nerolac	Asian Paints
		Berger	Ultratech	
105	Textured Exterior Paint	AkzoNobel (Dulux)	Asian (Apex Ultima)	Nerolac Kansai (Excel)
		Ultratech	Unitile Products	Berger
		Dr Fixit - (Rain Coat)		
106	Synthetic Enamel Paint	AkzoNobel (Dulux Gloss)	Asian (Apolite)	Kansai Nerolac
		Berger (Luxol Luster)	Ultratech	
108	Epoxy Paint	Kansai Nerolac	Asian AkzoNobel (Dulux)	FOSROC
		ICI	Berger	Ultratech
		Asian Paints		
109	Fire Paint / Fire retarded Paint	Asian Paints	ICI	AkzoNobel (Dulux)
		Berger	Amituff	Hampel
110	Cement Primer	Berger	Asian Paints	Dulux
		Nerolac	Ultratech	
111	Wall Putty - while cement based	Birla Wall Care	JK White	Saint Gobain
		Asian Paints	Berger	
112	Polyester Powder Coating Paints Repellent / Weather Sealant	Nerolac	Berger	AkzoNobel
		Ultratech	Asian Paints	STP
	8. DOOR, WINDOWS, PARTITIONS			
113	Steel windows / steel press metal frames	Steelman industries	PD industries	Metal windows
113a	Aluminium Door / Window Internal	Tostem	Eternia	Window Magic
		Finesta	Asahi	Or Any Equivalent

114	Wire mesh	Micromesh	India wire mesh	Sterling enterprises
115	Operable Partitions	Dorma	Hufcor	Hafele
		Azazo	GEZZE	
116	G.I. Steel Door Frame	Synergy Thrislington	Navair	Shakti
117	Automatic Sliding Door	Dorma	Hettich	Godrej
		SAPA Building Systems	Hafele	Ozone
118	Revolving doors	Dormakaba	Boonedam	Ozone
119	UPVC Doors & Windows	Fenesta	Glanz	Lingel / PSP
		veka	LG Hausys	NLC wintech
	9. HARDWARE			
120	Door/ Window Fittings incl. Door Closer / Floor Springs	Dormakaba	Geze	Hafele
		Dorset	Ozone	Hormann
		Hettich	Ipsa	
121	Hardware for Fire Check Door	Dormakaba	Geze	Hafele
		Hormann	Marshal	Godrej
		Dorset	Ipsa	
122	Friction Stay Hinges	Ebco	Hettich	Hafele
		Schuco	Sapa Building System	European Standard
		Rayners	Ipsa	
123	Stainless Steel Hardware	Dormakaba	Hafele	Geze
		Dorset	Hettich	Godrej
		Ozone	Ipsa	
124	Die Cast Patch Fittings	Dorma	Geze	AssaAbloy
		Hettich	Ozone	Dorset
125	SS Mortise lock with one dead bolt and pair of SS handles steel grade SS 304 / SS Mortise latch & lock with six levers and pair of SS handles steel grade SS304 / SS Tower bolt	Dorma	Geze	Hafele
		Assa Abloy	Dorset	Godrej
126	SS Butt hinges with ball bearing grade SS 304	Dorma	Hafele	Geze
		Hettich	Dorset	Godrej

		Ozone		
127	Pull handle back to back of length 150mm of Steel Grade SS 304	Dorma	Hafele	Geze
		Hettich	Dorset	Godrej
128	Lever handle in SS 304finish	Dorma	Hafele	Hettich
		Geze	Dorset	Godrej
129	Magic Eye	Dorma	Hettich	Geze
		Hafele	Dorset	Godrej
130	Lead lined door hardware	Lawrence	Gallery	Zero.
131	Stainless Steel plates 304 grade	Dormakaba	Hafele	Geze
132	Wooden door Fittings of Brushed Steel	Dorma	Hafele	Hettich
		Geze	Ozone	Dorset
115	Adhesive Tape	3M India	Norton	Apollo Industries
		BOPD	TESA	
116	Nuts / Bolts / Screws	Kundan	GKW	Boun
		Atul	Hilti	Arrow
117	Rollers for sliding / Flush lock for sliding / wool Pile with silent film / Window Hinges / Door Hinges	SAPA Building System	Godrej	Dorma
		Dorset	Hettich	Ozone
118	EPDM Gasket	Schuco	Sapa Building System	Victor
		Rayners	Hanu	Anand
119	Backer rod	Supreme	Silica	EPE
		Softex		
	10. FIRE DOORS / SEALANT			
120	Fire Sealant	Hilti	3M India	Fischer
		McCoy		
121	Fire Rated / check Doors	Navair	Shakti Hormann	Promat
		Mikasa	Sukriti	Kindel
		GMP	Iclean	JC Fire
122	Fire Resistant Glass / Vision Panels	Saint Gobain	Asahi	Glaverbel
		Pilkington	Ferlite	Schott
	11. FLUSH DOORS, BOARDS, LAMINATE			
123	Prelaminated Particle Board	Merino	Green ply	Century
		Archid	Amulya Mica	

124	PVC Rigid Sheet	VK CONCEPT	PINGER VINYL		
124	Flush Door / Laminated Flush Doors	Archid	Green	Merino	
		Century	Amulya Mica		
125	Laminate	Merino	Greenlam	Archid	
		Century	Amulya Mica		
126	High Pressure Compact Laminate Board:	Merino	Greenlam	Mikasa	
		Fundermax	Amulya Mica	Archid	
127	Veneered Particle Board	Merino	Duro	Greenlam	
		Archid	Green Ply	Amulya Mica	
128	Plywood / Boards	Merino	Green Ply	Century	
		Archid	Amulya Mica		
129	Plywood / Veneer	Merino	Archid	Green Ply	
130	Moisture Resistant Board	Saint Gobain	Gyprox	USG Boral	
		Greenlam	Duro	Merino	
		Archid	Green Ply		
131	Cement / Bison Board	EVEREST	NCL	VISHAKHA INDUSTRIES	
	12. ACOUSTIC WALL PANELING / DOORS				
132		Acoustics wooden slats wall panelling	ANUTONE	ARMSTRONG	KNAUF
			Heradesign	Ecotone Acoustics	Credence,
133	Acoustic doors / shutters	Stairway Studio	Signature Interiors	Envirotech System	
134	Stretch fabric wall panelling	Anutone	Walltracts	Clipso	
		Gyptech Systems	Envirotech System		
	13. MISCELLANOUS				
135	Stainless Steel Railing, Accessories etc. in Grade SS 304	Kich	D-Line	Ozone	
		Jindal	Koncept		
136	Wood adhesive	Fevicol	3M	Jivanjyor	
137	Glass / Rock wool Insulation	UP Twiga	Poly Glass	Owens corning	
		Lloyds	Rock wool India	Roxul Rockwool	
138	Vertical& Horizontal Blinds	Windowtech	Decorex	Dheeraj Craft	
		Deck	Vista levelor	Anjana Innovation	
		Deck Blind			
139	Roller Blinds	Vista	Hunter Douglas	Mac	
		Windowtech	Deck	D Decor	

140	Vinyl (PVC) Corner Guard	Windowtech	Decorex	Deck
		Construction Specialities	Inprocorp India Pvt. Ltd.	Gradus
		LSR	D Decor	
141	Vinyl Wall guard	Construction Specialities	Inprocorp India Pvt. Ltd.	Gradus
142	Handrail	Construction Specialities	Inprocorp India Pvt. Ltd.	Gradus
143	Vinyl Snap Handrail	Construction Specialities	Inprocorp India Pvt. Ltd.	Gradus
144	Toilet Cubicles	Merino	Greenlam	Fundermax
	FURNITURE			
145	Chairs	Godrej	Indo Innovations	Durian
146	Tables	Godrej	Indo Innovations	Durian
147	Sofas	Godrej	Indo Innovations	Durian
148	Wardrobes / cabinets / Hostel Beds	Godrej	Indo Innovations	Durian

Note: All Approved makes to comply with their respective specifications provided in tender.

PART- C

SUB- HEAD : DETAILED SCOPE OF WORK, PARTICULAR SPECIFICATIONS, SCHEDULE OF ITEMS & LIST OF APPROVED MAKES FOR –

PART-1 – SANITARY, PLUMBING & FIRE FIGHTING WORKS

PART 2 – ELECTRICAL & ALLIED WORKS

PART 3 – MECHANICAL WORKS

PART 4 – NURSE CALL SYSTEM, MGPS & MEDICAL SERVICES

PART 1

DETAILED SCOPE OF WORK

SANITARY PLUMBING & FIRE FIGHTING WORKS

I. Hospital Building

Sl. No	Item of work	Scope of Work-Hospital Building.
1.0	Internal Sanitary, Water Supply Installations.	
1.1	EWC Assembly	<p>Wall mounted EWC with Seat Cover & dual flushing concealed cistern suitable 3/6 Litres. for (with internal fittings) & dual push plate including WC Chair Bracket, WC Connector & all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge.</p> <p>Each EWC assembly shall be with following minimum number of fittings of approved make:</p> <ul style="list-style-type: none"> • CP brass Health Faucet (01 No.) with minimum 1 metre SS braided connection hose with Wall Bracket. • CP brass Angle Valve with Wall Flange, (01 No.) • CP brass Twin Bib Cock with Wall Flange (01 No.) • CP brass Twin Robe Hooks (01 No) • CP Brass Toilet Paper Holder (1 No.)
1.2	Indian WC Assembly	<p>Orissa pattern Indian WC with PVC cistern (with internal fittings) with flush bend including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer- in-Charge.</p> <p>Each WC assembly shall be with following minimum number of fittings of approved make:</p> <ul style="list-style-type: none"> • CP brass Angle Valve with Wall Flange, CP Copper Connection Pipe with Nuts & Washer (01 No.) • CP brass Long Body Bib Cock with Wall Flange (01 No.) • CP brass Twin Robe Hooks (01 No)
1.3	Wash basin assembly	<p>Under counter oval / rectangular shape wash basin including all accessories complete in all respect as per approved make list, architectural drawings and direction of Engineer-in-Charge.</p> <p>Each wash basin assembly shall be with following minimum number of fittings of approved make:</p> <p>Public & Common Toilets</p> <ul style="list-style-type: none"> • CP brass Pillar Tap for Cold Water (01 No.) • CP brass Angle Valve with Wall Flange, CP Copper Connection Pipe with Nuts & Washer (01 No.) • CP brass 32 mm dia. Bottle Trap (01 No.) • CP Waste Jali of required size (01 No.) • Liquid Soap Dispenser (1No. for Each Wash Basin) • Hand Dryer (1 No for Each Toilet) <p>Consultant/ IPD Toilets</p> <ul style="list-style-type: none"> • CP brass Basin Mixer (Pillar Type) for Cold & Hot Water (01 No.) • CP brass Angle Valve with Wall Flange, CP Copper Connection Pipe with Nuts & Washer (02 Nos.) • CP brass 32 mm dia. Bottle Trap (01 No.) • CP Waste Jali of required size (01 No.) • Soap Dispenser (1No. for Each Wash Basin)

		<ul style="list-style-type: none"> • CP Brass Towel Ring (1 No) <p>Critical Area Toilets</p> <ul style="list-style-type: none"> • CP brass No Touch sensor-based Tap (Pillar Type) for Cold & Hot Water (01 No.) • CP brass Angle Valve with Wall Flange, CP Copper Connection Pipe with Nuts & Washer (02 Nos.) • CP brass 32 mm dia. Bottle Trap (01 No.) • CP Waste Jali of required size (01 No.) • Soap Dispenser (1No. for Each Wash Basin) • CP Brass Towel Rail (1 No)
1.4	Bath Fittings Assembly	<p>Each bath assembly shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer- in-Charge:</p> <ul style="list-style-type: none"> • 3-in-1 wall mixture with provision of hot & cold water. (01 No.). • CP brass OH Shower rose minimum 100 mm (square/ round) with shower arm (01 No.). • CP brass Hand Shower (01 No.) • CP brass Floor Trap Jali (01 No.). • CP brass Towel Rail (01 No) • Corner Glass Shelf (01 No.) • CP brass Twin Robe Hook (01 No)
1.5	Kitchen Fittings	<p>Each kitchen area shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings and direction of Engineer-in-Charge:</p> <ul style="list-style-type: none"> • Stainless steel AISI 304 (18/8) Kitchen sink as per IS 13983 with drain board with minimum size 510x1040x250mm. • CP brass sink mixture (Wall Mounted) with provision of hot & cold water (01 No.). • CP brass Bottle Trap (01 No.) • CP brass floor Trap Jali (01 No). • CP brass bib cock short body (01 No for RO Water). • CP brass bib cock long body (01 No for utility area).
1.6	Laboratory Sink	<p>Each Lab area shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge:</p> <ul style="list-style-type: none"> • Polypropylene (PP) Lab sink without drain board with minimum size 600x450x250mm. • CP brass sink mixture (Slab Mounted) with provision of hot & cold water (01 No.). • CP brass Bottle Trap (01 No.) • CP brass floor Trap Jali (01 No).
1.7	Urinal Assembly for Common Toilets	<p>Each urinal assembly shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer- in-Charge:</p> <ul style="list-style-type: none"> • Urinal Bowl with CP brass Waste Jali (01 No)

		<ul style="list-style-type: none"> Frosted toughened glass partition of standard size for urinal on both side (02 Nos). No Touch automatic low voltage electric sensor based with Face Plate for Urinal Flushing (01 No). CP brass Bottle Trap (01 No).
1.8	Mirror	Float mirror of 6 mm thickness with beveled edges above counter of each wash basin slab must be provided with 8 mm thick HDF backing and to be covered with decorative type PVC laminated beading 50 mm wide all-around the mirror.
1.9	Soil, Waste & Vent Pipes and Fittings	<p>All Soil, Waste & Vent Pipes including fittings shall be Sound Insulated Mineral Reinforced 3- Layer Polypropylene (PP) Pipes exposed on walls and suspended below slabs using pre painted angle iron clamps with GI threaded rods of 10 mm dia and fixed over GI clamp (along with threaded U clamps) of minimum 3 mm thickness of appropriate size in the shafts to be fixed with appropriate capacity GI wedge type metal fasteners.</p> <p>90-degree bends to be avoided and to be provided with Y, YT, 45-degree bends and large radius bends in case of junctions, change of alignments.</p> <p>Sufficient cleanout plugs to be provided in each line and all traps to be provided with self-cleansing P trap/floor trap of minimum 100 mm dia. Joints of pipes to be provided with push fit joint with Rubber Ring as per manufacturer's specifications.</p> <p>Minimum dia of Soil & Waste pipe (Except Waste connection from Wash Basin, Sinks & Floor Drain) shall be 100 mm irrespective of design. Testing of joints to be conducted as per approved design & as per CPWD Specification 2019.</p> <p>Minimum dia. of Vent Pipes shall be 75 mm.</p> <p>Minimum Dia. of waste pipe from wash basin shall be 40 mm and from floor drain 63 mm.</p>
1.10	Water Supply Lines	<p>All internal water supply pipes concealed in walls shall be CPVC (SDR-11) pipes & fittings.</p> <p>All internal water supply pipes exposed on wall & terrace shall be CPVC Pipes & Fittings SDR-11 & Sch.80 Grade.</p> <p>All RO Water Supply lines shall be Stainless Steel 316 grade Pipes & Fittings.</p> <p>Isolation & Control Valves shall be Provided at required location of all pipes.</p> <p>Digital Water Meter with Valve Chamber shall be installed at incoming domestic, flushing & Soft water lines at Ground Level.</p>
1.11	Hot Water Supply	Hot Water supply for Hospital shall be through Heat Pumps installed at Terrace of Building.

		Hot Water Storage Tank - Hot water storage tank shall be of SS 316 L grade with necessary electrical backup. Tank shall be insulated with 100 mm thick glass wool insulation not less than 80 kg/cum density & wrapping by 24g aluminum sheet.
1.12	Capacity of Heat Pumps	<p>For Upper Two Floors</p> <p>2 Nos. x 20 KW Capacity (1 Working+1 Standby) Heat Pumps shall be Provided.</p> <p>1 No Plate Type Heat Exchanger Capacity 18920 K Cal./Hr.</p> <p>1 Set (1W+1S) Primary Recirculation Pumps Capacity 3800 LPH @ 20 M, Head.</p> <p>1 Set (1W+1S) Secondary Recirculation Pumps Capacity 3800 LPH @ 20 M, Head.</p> <p>1 No. x 3000 Litres Capacity Hot water storage tank of SS 316 L grade with necessary electrical backup shall be Provided.</p> <p>All other equipment's & instruments required for proper operation of system i.e. Hot water return/recirculation pumps, PHE, Pressure & Temp. Gauges etc. are part of installation.</p> <p>For All Other Floors</p> <p>3 Nos. x 70 KW Capacity (2 Working+1 Standby) Heat Pumps shall be Provided.</p> <p>2 Nos. x 7500 Litres Capacity Hot water storage tank of SS 316 L grade with necessary electrical backup shall be Provided.</p> <p>1 No Plate Type Heat Exchanger Capacity 132500 K Cal./Hr.</p> <p>1 Set (1W+1S) Primary Recirculation Pumps Capacity 12400 LPH @ 25 M, Head.</p> <p>1 Set (1W+1S) Secondary Recirculation Pumps Capacity 26500 LPH @ 25 M, Head.</p> <p>All other equipment's & instruments required for proper operation of system i.e. Hot water return/recirculation pumps, PHE, Pressure & Temp. Gauges etc. are part of installation.</p>
1.13	Insulation for Hot Water Pipes	<p>Internal Toilets- 6 mm thick Nitrile Rubber Tube Section.</p> <p>Exposed vertical in shaft- 9 mm thick Nitrile Rubber Tube Section with IC Clad covering (reinforced glass fibre fabric).</p> <p>Exposed at Terrace- 13 mm thick Nitrile Rubber Tube Section with 24-gauge aluminium cladding.</p>

1.14	RO Water	<p>Centralized R.O plant with SS-316 Grade RO Water Storage Tank to be installed at terrace of Hospital building for Clinical, Medical & drinking water requirement of Hospital Building Except Dialysis Requirement. A Local RO Unit is provided for Dialysis Requirement as per Medical Parameters.</p> <p>1 No. x 1200 LPH Capacity RO Plant shall be Provided,</p> <p>1No. x 6000 Litres Capacity RO Water Storage Tank shall be Provided.</p>
1.15	Drinking Water	<p>Water cooler shall be provided at various locations & floors of Hospital, for drinking water purpose as shown in Drawings.</p> <p>Water Cooler capacity- 60 LPH Cooling Capacity & 80 Litres Storage Capacity.</p>
1.16	Over Head Tank	<p>Provision of RCC tanks of designed capacity for supply of drinking, domestic, flushing water use including partition/ separate tank for firefighting requirement as per NBC-2016 norms.</p> <p>Minimum Capacity of OH Tanks:</p> <p>Fire Water Tank = 20 KL Domestic Water Tank = 105 KL Flushing Water Tank = 50 KL Soft Water Tank = 135 KL</p>
1.17	Water Distribution	<p>Distribution of domestic water in Hospital shall be through gravity from Terrace Tank except upper two floors. Upper two floors of these buildings shall be fed by hydro pneumatic system.</p> <p>Distribution of flushing water in all Floors shall be through gravity from terrace water tank.</p> <p>Distribution of RO water through gravity from terrace tank.</p> <p>Capacity of hydro pneumatic system for upper two floors: Two Pumps (1 working+ 1 Standby). 3.0 LPS @ 25M. Head.</p>
2.0	Rain Water Pipes	
2.1	Hospital Building	<p>Syphonic Rain Water Disposal System (Roof Drainage) shall be Provided for Hospital Building with HDPE pipes & other required fittings/fixtures as per manufacturer Specifications.</p>
3.0	Fire Fighting System	<p>Entire Fire Fighting System of Building shall be installed as per NBC-2016 and local Fire Authority Norms.</p>
3.1	Fire Extinguishers	<p>The sufficient qty. of portable/trolley mounted type fire extinguishers (Gas Based stored pressure type CO2 type /ABC Powder Type/ Mechanical Foam etc.) shall be provided at all levels of the building at strategic locations as per requirements, generally to follow NBC- 2016 and IS - 2190: 1992 to extinguish fire of class A, B ,C.</p>

		<p>Clean agent fire extinguishers to be provided in laboratories.</p> <p>All Fire Extinguishers shall be Halon Free.</p>
3.2	Internal Hydrants	<p>Internal Hydrant station shall comprise of:</p> <p>1 No. stainless steel single headed landing hydrant valve with 80 mm dia. flange inlet and 63 mm dia with 80 mm dia CI Butter fly Valve,</p> <p>1 No. swinging type First Aid hose reel in red colour drum with 36.5 mtr long and 20 mm dia heavy duty rubber hose with 20 mm dia. globe valve stop cock & Stainless-Steel coupling & nozzle of 5mm outlet with shut off valve.</p> <p>1 No. 63mm dia. Stainless Steel branch pipe with Stainless Steel nozzle of 20 mm nominal bore outlet with instantaneous type 63 mm dia. coupling.</p> <p>1 No. fireman's axe with heavy duty insulated rubber handle.</p> <p>2 Nos. of 15 m long Non-Percolating Hose Pipe.</p> <p>1 No. MS Door Shutter made up of 16 gauge MS Sheet of 2100x1200 mm size with front glass with lock and key arrangement.</p>
3.3	Automatic Sprinkler System	<p>Automatic sprinkler system shall be provided as per requirements of NBC 2016 or relevant IS codes.</p> <p>As per hazard classifications, maximum/minimum distance between sprinklers, between sprinkler & walls to be maintained. Coverage area of each sprinkler & assumed maximum area of operation shall conform to relevant IS codes.</p> <p>Side wall/pendant/upright sprinklers to be provided as per requirements, shall be UL & FM certified, complete with rosette plate, glass bulb temperature rating of 68 degree Celsius (red colour), Quick response type, chrome plated finish & in compliance with NBC 2016 & relevant IS codes.</p> <p>Suitable Nos. of Installation control Valve (ICVs) to be considered consisting all accessories (Butterfly valve, Y strainer, water gong, Alarm Valve, drain valve, Pressure gauge etc.) conforming to latest IS codes.</p> <p>Sprinkler shall be selected as per temperature rating which shall be based on usage type. Colour code shall be in conformance to relevant IS codes.</p> <p>Inspection test assembly/zonal control valve complete with flow switch & other related accessories (NRV/Butterfly, drain valve, Pressure gauge, sight glass etc.) to be provided in each floor sprinkler riser.</p> <p>Flexible pipe for connecting sprinklers (braided type) & UL & FM certified to be considered of various sizes as per site conditions to maintain symmetry & crossing of ducts & other utilities.</p>
3.4	Gas based Fire Suppression System	<p>The Total Room Flooding system with Halo carbon based clean agent gas (UL Listed) approved by NFPA 2001 latest addition or any other clean agent gas (UL Listed) approved by NFPA is Provided in Server Room, UPS Room,</p>

		MRI, CT scan where Water sprinklers cannot be used. The Gas cylinder assembly should be UL/FM approved with seamless CCOE approved cylinder and will be connected to discharge nozzles through metal Piping. The master cylinder Kit fitted on Gas cylinder will be operated through separate Fire detection Panel and will release zero Ozone depletion potential Gas through the nozzles in case of fire.
3.5	Terrace Tank	RCC Terrace Fire Tank of 20000 Litres capacity shall be Provided as per NBC-2016.
3.6	Terrace Pump	Fire Pump at Terrace Fire tank is not required as per NBC-2016.
3.7	Fire Pipes	Mild Steel class 'C' tubes confirming to IS: 1239/3589 shall be used in Fire Fighting System. All Fire Pipes shall be painted with two or more coat of postal red colour synthetic enamel paint over a coat of steel primer (Both are approved quality and make).
3.8	Pipe Jointing	Mild Steel Pipes up to 50 mm dia shall be jointed with forged steel threaded fittings, no welding is allowed. Mild Steel Pipes 65 mm & above dia shall be jointed with welding joint with standard MS heavy class Fittings.
II.		R&D Centre Building
Sl. No	Item of work	Scope of Work- R&D Centre Building.
1.0	Internal Sanitary, Water Supply Installations.	
1.1	EWC Assembly	Wall mounted EWC with Seat Cover & dual flushing concealed cistern suitable 3/6 Litres. for (with internal fittings) & dual push plate including WC Chair Bracket, WC Connector & all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge.
		Each EWC assembly shall be with following minimum number of fittings of approved make: <ul style="list-style-type: none"> • CP brass Health Faucet (01 No.) with minimum 1 metre SS braided connection hose with Wall Bracket. • CP brass Angle Valve with Wall Flange, (01 No.) • CP brass Twin Bib Cock with Wall Flange (01 No.) • CP brass Twin Robe Hooks (01 No) • CP Brass Toilet Paper Holder (1 No.)
1.2	Indian WC Assembly	Orissa pattern Indian WC with PVC cistern (with internal fittings) with flush bend including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer- in-Charge. Each WC assembly shall be with following minimum number of fittings of approved make: <ul style="list-style-type: none"> • CP brass Angle Valve with Wall Flange, CP Copper Connection Pipe with Nuts & Washer (01 No.) • CP brass Long Body Bib Cock with Wall Flange (01 No.) • CP brass Twin Robe Hooks (01 No)
1.3	Wash basin assembly	Under counter oval / rectangular shape wash basin including all accessories complete in all respect as per approved make list, architectural drawings and direction of Engineer-in-Charge.

		<p>Each wash basin assembly shall be with following minimum number of fittings of approved make:</p> <ul style="list-style-type: none"> • CP brass Pillar Tap for Cold Water (01 No.) • CP brass Angle Valve with Wall Flange, CP Copper Connection Pipe with Nuts & Washer (01 No.) • CP brass 32 mm dia. Bottle Trap (01 No.) • CP Waste Jali of required size (01 No.) • Liquid Soap Dispenser (1No. for Each Wash Basin) • Hand Dryer (1 No for Each Toilet)
1.4	Kitchen /PANTRY Fittings	<p>Each kitchen area shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings and direction of Engineer-in-Charge:</p> <ul style="list-style-type: none"> • Stainless steel AISI 304 (18/8) Kitchen sink as per IS 13983 with drain board with minimum size 510x1040x250mm. • CP brass sink mixture (Wall Mounted) with provision of hot & cold water (01 No.). • CP brass Bottle Trap (01 No.) • CP brass floor Trap Jali (01 No). • CP brass bib cock short body (01 No for RO Water). • CP brass bib cock long body (01 No for utility area).
1.5	Laboratory Sink	<p>Each Lab area shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge:</p> <ul style="list-style-type: none"> • Polypropylene (PP) Lab sink without drain board with minimum size 600x450x250mm. • CP brass sink mixture (Slab Mounted) with provision of hot & cold water (01 No.). • CP brass Bottle Trap (01 No.) • CP brass floor Trap Jali (01 No).
1.6	Urinal Assembly for Common Toilets	<p>Each urinal assembly shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer- in-Charge:</p> <ul style="list-style-type: none"> • Urinal Bowl with CP brass Waste Jali (01 No) • Frosted toughened glass partition of standard size for urinal on both side (02 Nos). • No Touch automatic low voltage electric sensor based with Face Plate for Urinal Flushing (01 No). • CP brass Bottle Trap (01 No).
1.7	Mirror	<p>Float mirror of 6 mm thickness with beveled edges above counter of each wash basin slab must be provided with 8 mm thick HDF backing and to be covered with decorative type PVC laminated beading 50 mm wide all-around the mirror.</p>
1.8	Soil, Waste & Vent Pipes and Fittings	<p>All Soil, Waste & Vent Pipes including fittings shall be Sound Insulated Mineral Reinforced 3- Layer Polypropylene (PP) Pipes exposed on walls and suspended below slabs using pre painted angle iron clamps with GI threaded rods of 10 mm dia and fixed over GI clamp (along with threaded U clamps) of minimum 3 mm thickness of appropriate size in the shafts to be fixed with appropriate capacity GI wedge type metal fasteners.</p>

		<p>90-degree bends to be avoided and to be provided with Y, YT, 45-degree bends and large radius bends in case of junctions, change of alignments.</p> <p>Sufficient cleanout plugs to be provided in each line and all traps to be provided with self-cleansing P trap/floor trap of minimum 100 mm dia. Joints of pipes to be provided with push fit joint with Rubber Ring as per manufacturer's specifications.</p> <p>Minimum dia of Soil & Waste pipe (Except Waste connection from Wash Basin, Sinks & Floor Drain) shall be 100 mm irrespective of design. Testing of joints to be conducted as per approved design & as per CPWD Specification 2019.</p> <p>Minimum dia. of Vent Pipes shall be 75 mm.</p> <p>Minimum Dia. of waste pipe from wash basin shall be 40 mm and from floor drain 63 mm.</p>
1.9	Water Supply Lines	<p>All internal water supply pipes concealed in walls shall be CPVC (SDR-11) pipes & fittings.</p> <p>All internal water supply pipes exposed on wall & terrace shall be CPVC Pipes & Fittings SDR-11 & Sch.80 Grade.</p> <p>All RO Water Supply lines shall be Stainless Steel 316 grade Pipes & Fittings.</p> <p>Isolation & Control Valves shall be Provided at required location of all pipes.</p> <p>Digital Water Meter shall be installed at incoming domestic & flushing lines at Ground Level.</p>
1.10	RO Water	<p>Centralized R.O plant with SS-316 Grade RO Water Storage Tank to be installed at terrace of building for drinking water requirement of R&D Centre Building.</p> <p>2Nos. x 75 LPH Capacity RO Plant shall be Provided 1No. x 500 Litres Capacity RO Water Storage Tank shall be Provided.</p>
1.11	Drinking Water	<p>Water cooler shall be provided at various locations & floors of R&D Centre, for drinking water purpose as shown in Drawings.</p> <p>Water Cooler capacity- 60 LPH Cooling Capacity & 80 Litres Storage Capacity.</p>
1.12	Over Head Tank	<p>Provision of RCC tanks of designed capacity for supply of domestic, flushing water use including partition/ separate tank for firefighting requirement as per NBC-2016 norms.</p> <p>Minimum Capacity of OH Tanks:</p> <p>Fire Water Tank = 25 KL Domestic Water Tank = 5 KL Flushing Water Tank = 5 KL</p>

1.13	Water Distribution	Distribution of domestic water in R&D Centre shall be through gravity from Terrace Tank. Distribution of flushing water in all Floors shall be through gravity from terrace water tank. Distribution of RO water through gravity from terrace tank.
2.0	Rain Water Pipes	
2.1	R&D Centre Building	Rain Water pipes including their fittings from terraces & balconies of building shall be Unplasticized Rigid uPVC rainwater pipes of minimum 110 mm dia, conforming to IS: 13592 Type B,
3.0	Fire Fighting System	Entire Fire Fighting System of Building shall be installed as per NBC-2016 and local Fire Authority Norms as per Fire Fighting Drawings.
3.1	Fire Extinguishers	The sufficient qty. of portable/trolley mounted type fire extinguishers (Gas Based stored pressure type CO2 type /ABC Powder Type/ Mechanical Foam etc.) shall be provided at all levels of the building at strategic locations as per requirements, generally to follow NBC- 2016 and IS – 2190: 1992 to extinguish fire of class A, B ,C. All Fire Extinguishers shall be Halon Free.
3.2	Internal Hydrants	Internal Hydrant station shall comprise of: 1 No. stainless steel single headed landing hydrant valve with 80 mm dia. flange inlet and 63 mm dia with 80 mm dia CI Butter fly Valve, 1 Number swinging type First Aid hose reel in red colour drum with 36.5 mtr long and 20 mm dia heavy duty rubber hose with 20 mm dia. globe valve stop cock & Stainless-Steel coupling & nozzle of 5mm outlet with shut off valve. 1 No. 63mm dia. Stainless Steel branch pipe with Stainless Steel nozzle of 20 mm nominal bore outlet with instantaneous type 63 mm dia. coupling. 1 No. fireman’s axe with heavy duty insulated rubber handle. 2 Nos. of 15 m long Non-Percolating Hose Pipe. 1 No. MS Door Shutter made up of 16-gauge MS Sheet of 2100x1200 mm size with front glass with lock and key arrangement.
3.3	Terrace Tank	RCC Terrace Fire Tank of 25000 Litres capacity shall be Provided as per NBC-2016.
3.4	Terrace Pump	Fire Pump of 900 LPM @ 35 M. Head at Terrace Fire tank is not required as per NBC-2016.
3.5	Fire Pipes	Mild Steel class ‘C’ tubes confirming to IS: 1239/3589 shall be used in Fire Fighting System. All Fire Pipes shall be painted with two or more coat of postal red colour synthetic enamel paint over a coat of steel primer (Both are approved quality and make).
3.6	Pipe Jointing	Mild Steel Pipes up to 50 mm dia shall be jointed with forged steel

		threaded fittings, no welding is allowed. Mild Steel Pipes 65 mm & above dia shall be jointed with welding joint with standard MS heavy class Fittings.
III.		Nurse Hostel
Sl. No	Item of work	Scope of Work – Nurse Hostel.
1.0	Internal Sanitary, Water Supply Installations.	
1.1	EWC Assembly	Wall mounted EWC with Seat Cover & dual flushing concealed cistern suitable 3/6 Litres. for (with internal fittings) & dual push plate including WC Chair Bracket, WC Connector & all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge.
		Each EWC assembly shall be with following minimum number of fittings of approved make: <ul style="list-style-type: none"> • CP brass Health Faucet (01 No.) with minimum 1 metre SS braided connection hose with Wall Bracket. • CP brass Angle Valve with Wall Flange, (01 No.) • CP brass Twin Bib Cock with Wall Flange (01 No.) • CP brass Twin Robe Hooks (01 No) • CP Brass Toilet Paper Holder (1 No.)
1.2	Wash basin assembly	Under counter oval / rectangular shape wash basin including all accessories complete in all respect as per approved make list, architectural drawings and direction of Engineer-in-Charge. Each wash basin assembly shall be with following minimum number of fittings of approved make: <ul style="list-style-type: none"> • CP brass Basin Mixer (Pillar Type) for Cold & Hot Water (01 No.). • CP brass Angle Valve with Wall Flange, CP Copper Connection Pipe with Nuts & Washer (02 Nos.). • CP brass 32 mm dia. Bottle Trap (01 No.). • CP Waste Jali of required size (01 No.). • Soap Dispenser (1No. for Each Wash Basin). • CP Brass Towel Ring (1 No).
1.3	Bath Fittings Assembly	Each bath assembly shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer- in-Charge: <ul style="list-style-type: none"> • 3-in-1 wall mixture with provision of hot & cold water. (01 No.). • CP brass OH Shower rose minimum 100 mm (square/ round) with shower arm (01 No.). • CP brass Hand Shower (01 No.) • CP brass Floor Trap Jali (01 No.). • CP brass Towel Rail (01 No) • Corner Glass Shelf (01 No.)

		<ul style="list-style-type: none"> CP brass Twin Robe Hook (01 No)
1.4	Kitchen Fittings	<p>Each kitchen area shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge:</p> <ul style="list-style-type: none"> Stainless steel AISI 304 (18/8) Kitchen sink as per IS 13983 with drain board with minimum size 510x1040x250mm. CP brass sink mixture (Wall Mounted) with provision of hot & cold water (01 No.). CP brass Bottle Trap (01 No.) CP brass floor Trap Jali (01 No). CP brass bib cock short body (01 No for RO Water). CP brass bib cock long body (01 No for utility area).
1.5	Mirror	<p>Float mirror of 6 mm thickness with beveled edges above counter of each wash basin slab must be provided with 8 mm thick HDF backing and to be covered with decorative type PVC laminated beading 50 mm wide all-around the mirror.</p>
1.6	Soil, Waste & Vent Pipes and Fittings	<p>All Soil, Waste & Vent Pipes including fittings shall be Sound Insulated Mineral Reinforced 3- Layer Polypropylene (PP) Pipes exposed on walls and suspended below slabs using pre painted angle iron clamps with GI threaded rods of 10 mm dia and fixed over GI clamp (along with threaded U clamps) of minimum 3 mm thickness of appropriate size in the shafts to be fixed with appropriate capacity GI wedge type metal fasteners.</p> <p>90-degree bends to be avoided and to be provided with Y, YT, 45-degree bends and large radius bends in case of junctions, change of alignments.</p> <p>Sufficient cleanout plugs to be provided in each line and all traps to be provided with self-cleansing P trap/floor trap of minimum 100 mm dia. Joints of pipes to be provided with push fit joint with Rubber Ring as per manufacturer's specifications.</p> <p>Minimum dia of Soil & Waste pipe (Except Waste connection from Wash Basin, Sinks & Floor Drain) shall be 100 mm irrespective of design. Testing of joints to be conducted as per approved design & as per CPWD Specification 2019.</p> <p>Minimum dia. of Vent Pipes shall be 75 mm.</p> <p>Minimum Dia. of waste pipe from wash basin shall be 40 mm and from floor drain 63 mm.</p>
1.7	Water Supply Lines	<p>All internal water supply pipes concealed in walls shall be CPVC (SDR-11) pipes & fittings.</p> <p>All internal water supply pipes exposed on wall & terrace shall be CPVC Pipes & Fittings SDR-11 & Sch.80 Grade.</p> <p>All RO Water Supply lines shall be Stainless Steel 316 grade Pipes & Fittings.</p> <p>Isolation & Control Valves shall be Provided at required location of all pipes.</p>

		Digital Water Meter shall be installed at incoming domestic & flushing water lines at Ground Level.
1.8	Hot Water Supply	<p>Hot Water supply for Nurse Hostel shall be through combination of solar water heating system and heat Pumps. The capacity of solar water heating system is equal to 20% of hot water demand and heat pump capacity of equal to 100% of hot water demand.</p> <p>Hot Water Storage Tank - Hot water storage tank shall be of SS 316 L grade with necessary electrical backup. Tank shall be insulated with 100 mm thick glass wool insulation not less than 80 kg/cum density & wrapping by 24g aluminum sheet.</p>
1.9	Capacity of Heat Pumps	<p>For Upper Two Floors Capacity</p> <p>1 Nos. x 6 KW Capacity Heat Pumps shall be Provided.</p> <p>1 Nos. x 1000 Litres Capacity Hot water storage tank of SS 316 L grade with necessary electrical backup shall be Provided.</p> <p>All other equipment's & instruments required for proper operation of system i.e. Hot water return/recirculation pumps, Pressure & Temp. Gauges etc. are part of installation.</p> <p>For Other Floors</p> <p>1 Nos. x 20 KW Capacity Heat Pumps shall be Provided.</p> <p>1 No Plate Type Heat Exchanger Capacity 18920 K Cal./Hr.</p> <p>1 Set (1W+1S) Primary Recirculation Pumps Capacity 3800 LPH @ 20 M, Head.</p> <p>1 Set (1W+1S) Secondary Recirculation Pumps Capacity 3800 LPH @ 20 M, Head.</p> <p>6 Nos. Solar Panels shall be Provided.</p> <p>1 Nos. x 2500 Litres Capacity Hot water storage tank of SS 316 L grade with necessary electrical backup shall be Provided.</p> <p>All other equipment's & instruments required for proper operation of system i.e. Hot water return/recirculation pumps, PHE, Pressure & Temp. Gauges etc. are part of installation.</p>
1.10	Insulation for Hot Water Pipes	<p>Internal Toilets- 6 mm thick Nitrile Rubber Tube Section.</p> <p>Exposed vertical in shaft- 9 mm thick Nitrile Rubber Tube Section with IC Clad covering (reinforced glass fibre fabric).</p> <p>Exposed at Terrace- 13 mm thick Nitrile Rubber Tube Section with 24-</p>

		gauge aluminium cladding.
1.11	Drinking Water	Water cooler with RO unit shall be provided at various locations & floors of Nurse Hostel for drinking water purpose as shown in Drawings. RO Unit capacity- 50 LPH Capacity. Water Cooler capacity- 60 LPH Cooling Capacity & 80 Litres Storage Capacity.
1.12	Over Head Tank	Provision of RCC tanks of designed capacity for supply of drinking, domestic, flushing water use including partition/ separate tank for firefighting requirement as per NBC-2016 norms. Minimum Capacity of OH Tanks: Fire Water Tank = 25 KL Domestic Water Tank = 9 KL Flushing Water Tank = 5 KL
1.13	Water Distribution	Distribution of domestic water in Nurse Hostel shall be through gravity from Terrace Tank except upper two floors. Upper two floors of these buildings shall be fed by hydro pneumatic system. Distribution of flushing water in all Floors shall be through gravity from terrace water tank. Capacity of hydro pneumatic system for upper two floors: Two Pumps (1 working+ 1 Standby). 2.0 LPS @ 25M. Head.
2.0	Rain Water Pipes	
2.1	Nurse Hostel	Rain Water pipes including their fittings from terraces & balconies of building shall be Unplasticized Rigid uPVC rainwater pipes of minimum 110 mm dia, conforming to IS: 13592 Type B,
3.0	Fire Fighting System	Entire Fire Fighting System of Building shall be installed as per NBC-2016 and local Fire Authority Norms.
3.1	Fire Extinguishers	The sufficient qty. of portable/trolley mounted type fire extinguishers (Gas Based stored pressure type CO2 type /ABC Powder Type/ Mechanical Foam etc.) shall be provided at all levels of the building at strategic locations as per requirements, generally to follow NBC- 2016 and IS – 2190: 1992 to extinguish fire of class A, B ,C. Clean agent fire extinguishers to be provided in laboratories. All Fire Extinguishers shall be Halon Free.
3.2	Internal Hydrants	Internal Hydrant station shall comprise of: 1 No. stainless steel single headed landing hydrant valve with 80 mm dia. flange inlet and 63 mm dia with 80 mm dia CI Butter fly Valve,

		<p>1 No. swinging type First Aid hose reel in red colour drum with 36.5 mtr long and 20 mm dia heavy duty rubber hose with 20 mm dia. globe valve stop cock & Stainless-Steel coupling & nozzle of 5mm outlet with shut off valve.</p> <p>1 No. 63mm dia. Stainless Steel branch pipe with Stainless Steel nozzle of 20 mm nominal bore outlet with instantaneous type 63 mm dia. coupling.</p> <p>1 No. fireman's axe with heavy duty insulated rubber handle.</p> <p>2 Nos. of 15 m long Non-Percolating Hose Pipe.</p> <p>1 No. MS Door Shutter made up of 16 gauge MS Sheet of 2100x1200 mm size with front glass with lock and key arrangement.</p>
3.3	Terrace Tank	RCC Terrace Fire Tank of 25000 Litres capacity shall be Provided as per NBC-2016.
3.4	Terrace Pump	Fire Pump of 900 LPM @ 35 M. Head at Terrace Fire tank is not required as per NBC-2016.
3.5	Fire Pipes	<p>Mild Steel class 'C' tubes confirming to IS: 1239/3589 shall be used in Fire Fighting System.</p> <p>All Fire Pipes shall be painted with two or more coat of postal red colour synthetic enamel paint over a coat of steel primer (Both are approved quality and make).</p>
3.6	Pipe Jointing	<p>Mild Steel Pipes up to 50 mm dia shall be jointed with forged steel threaded fittings, no welding is allowed.</p> <p>Mild Steel Pipes 65 mm & above dia shall be jointed with welding joint with standard MS heavy class Fittings.</p>
IV.		Resident Hostel & Guest House
Sl. No	Item of work	Scope of Work- Resident Hostel & Guest House.
1.0	Internal Sanitary, Water Supply Installations.	
1.1	EWC Assembly	<p>Wall mounted EWC with Seat Cover & dual flushing concealed cistern suitable 3/6 Litres. for (with internal fittings) & dual push plate including WC Chair Bracket, WC Connector & all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge.</p>
		<p>Each EWC assembly shall be with following minimum number of fittings of approved make:</p> <ul style="list-style-type: none"> • CP brass Health Faucet (01 No.) with minimum 1 metre SS braided connection hose with Wall Bracket. • CP brass Angle Valve with Wall Flange, (01 No.) • CP brass Twin Bib Cock with Wall Flange (01 No.) • CP brass Twin Robe Hooks (01 No) <p>CP Brass Toilet Paper Holder (1 No.)</p>

1.2	Wash basin assembly	<p>Under counter oval / rectangular shape wash basin including all accessories complete in all respect as per approved make list, architectural drawings and direction of Engineer-in-Charge.</p> <p>Each wash basin assembly shall be with following minimum number of fittings of approved make:</p> <ul style="list-style-type: none"> • CP brass Basin Mixer (Pillar Type) for Cold & Hot Water (01 No.). • CP brass Angle Valve with Wall Flange, CP Copper Connection Pipe with Nuts & Washer (02 Nos.). • CP brass 32 mm dia. Bottle Trap (01 No.). • CP Waste Jali of required size (01 No.). • Soap Dispenser (1No. for Each Wash Basin). • CP Brass Towel Ring (1 No).
1.3	Bath Fittings Assembly	<p>Each bath assembly shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer- in-Charge:</p> <p>Resident Hostel</p> <ul style="list-style-type: none"> • 3-in-1 wall mixture with provision of hot & cold water. (01 No.). • CP brass OH Shower rose minimum 100 mm (square/ round) with shower arm (01 No.). • CP brass Hand Shower (01 No.) • CP brass Floor Trap Jali (01 No.). • CP brass Towel Rail (01 No) • Corner Glass Shelf (01 No.) • CP brass Twin Robe Hook (01 No) <p>Guest House</p> <ul style="list-style-type: none"> • Concealed Mixer Diverter with concealed and exposed part for hot & cold water. (01 No.). • CP brass OH Shower rose minimum 100 mm (square/ round) with shower arm (01 No.). • CP brass Bath Spout (01 No.) • CP brass Floor Trap Jali (01 No.). • CP brass Towel Rail (01 No) • Corner Glass Shelf (01 No.) • CP brass Twin Robe Hook (01 No)
1.4	Kitchen Fittings	<p>Each kitchen area shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge:</p> <ul style="list-style-type: none"> • Stainless steel AISI 304 (18/8) Kitchen sink as per IS 13983 with drain board with minimum size 510x1040x250mm. • CP brass sink mixture (Wall Mounted) with provision of hot & cold water (01 No.). • CP brass Bottle Trap (01 No.) • CP brass floor Trap Jali (01 No).

		<ul style="list-style-type: none"> • CP brass bib cock short body (01 No for RO Water). • CP brass bib cock long body (01 No for utility area).
1.5	Urinal Assembly for Common Toilets	<p>Each urinal assembly shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer- in-Charge:</p> <ul style="list-style-type: none"> • Urinal Bowl with CP brass Waste Jali (01 No) • Frosted toughened glass partition of standard size for urinal on both side (02 Nos). • No Touch automatic low voltage electric sensor based with Face Plate for Urinal Flushing (01 No). • CP brass Bottle Trap (01 No).
1.6	Mirror	<p>Float mirror of 6 mm thickness with beveled edges above counter of each wash basin slab must be provided with 8 mm thick HDF backing and to be covered with decorative type PVC laminated beading 50 mm wide all-around the mirror.</p>
1.7	Soil, Waste & Vent Pipes and Fittings	<p>All Soil, Waste & Vent Pipes including fittings shall be Sound Insulated Mineral Reinforced 3- Layer Polypropylene (PP) Pipes exposed on walls and suspended below slabs using pre painted angle iron clamps with GI threaded rods of 10 mm dia and fixed over GI clamp (along with threaded U clamps) of minimum 3 mm thickness of appropriate size in the shafts to be fixed with appropriate capacity GI wedge type metal fasteners.</p> <p>90-degree bends to be avoided and to be provided with Y, YT, 45-degree bends and large radius bends in case of junctions, change of alignments.</p> <p>Sufficient cleanout plugs to be provided in each line and all traps to be provided with self-cleansing P trap/floor trap of minimum 100 mm dia. Joints of pipes to be provided with push fit joint with Rubber Ring as per manufacturer's specifications.</p> <p>Minimum dia of Soil & Waste pipe (Except Waste connection from Wash Basin, Sinks & Floor Drain) shall be 100 mm irrespective of design. Testing of joints to be conducted as per approved design & as per CPWD Specification 2019.</p> <p>Minimum dia. of Vent Pipes shall be 75 mm.</p> <p>Minimum Dia. of waste pipe from wash basin shall be 40 mm and from floor drain 63 mm.</p>
1.8	Water Supply Lines	<p>All internal water supply pipes concealed in walls shall be CPVC (SDR-11) pipes & fittings.</p> <p>All internal water supply pipes exposed on wall & terrace shall be CPVC Pipes & Fittings SDR-11 & Sch.80 Grade.</p> <p>All RO Water Supply lines shall be Stainless Steel 316 grade Pipes & Fittings.</p> <p>Isolation & Control Valves shall be Provided at required location of all pipes.</p>

		Digital Water Meter shall be installed at incoming domestic & flushing water lines at Ground Level.
1.9	Hot Water Supply	<p>Hot Water supply for Resident Hostel & Guest House shall be through combination of solar water heating system and heat Pumps. The capacity of solar water heating system is equal to 20% of hot water demand and heat pump capacity of equal to 100% of hot water demand.</p> <p>Hot Water Storage Tank - Hot water storage tank shall be of SS 316 L grade with necessary electrical backup. Tank shall be insulated with 100 mm thick glass wool insulation not less than 80 kg/cum density & wrapping by 24g aluminum sheet.</p>
1.10	Capacity of Heat Pumps	<p>For Upper Two Floors Capacity.</p> <p>1 Nos. x 6 KW Capacity Heat Pumps shall be Provided.</p> <p>1 Nos. x 1000 Litres Capacity Hot water storage tank of SS 316 L grade with necessary electrical backup shall be Provided.</p> <p>All other equipment's & instruments required for proper operation of system i.e. Hot water return/recirculation pumps, Pressure & Temp. Gauges etc. are part of installation.</p> <p>For Other Floors</p> <p>1 Nos. x 20 KW Capacity Heat Pumps shall be Provided.</p> <p>1 No Plate Type Heat Exchanger Capacity 18920 K Cal./Hr.</p> <p>1 Set (1W+1S) Primary Recirculation Pumps Capacity 3800 LPH @ 20 M, Head.</p> <p>1 Set (1W+1S) Secondary Recirculation Pumps Capacity 3800 LPH @ 20 M, Head.</p> <p>6 Nos. Solar Panels shall be Provided.</p> <p>1 Nos. x 2500 Litres Capacity Hot water storage tank of SS 316 L grade with necessary electrical backup shall be Provided.</p> <p>All other equipment's & instruments required for proper operation of system i.e. Hot water return/recirculation pumps, PHE, Pressure & Temp. Gauges etc. are part of installation.</p>
1.11	Insulation for Hot Water Pipes	<p>Internal Toilets- 6 mm thick Nitrile Rubber Tube Section.</p> <p>Exposed vertical in shaft- 9 mm thick Nitrile Rubber Tube Section with IC Clad covering (reinforced glass fibre fabric).</p> <p>Exposed at Terrace- 13 mm thick Nitrile Rubber Tube Section with 24-gauge aluminium cladding.</p>

1.12	Drinking Water	Water cooler with RO unit shall be provided at various locations & floors of Nurse Hostel for drinking water purpose as shown in Drawings. RO Unit capacity- 50 LPH Capacity. Water Cooler capacity- 60 LPH Cooling Capacity & 80 Litres Storage Capacity.
1.13	Over Head Tank	Provision of RCC tanks of designed capacity for supply of drinking, domestic, flushing water use including partition/ separate tank for firefighting requirement as per NBC-2016 norms. Minimum Capacity of OH Tanks: Fire Water Tank = 25 KL Domestic Water Tank = 8 KL Flushing Water Tank = 4 KL
1.14	Water Distribution	Distribution of domestic water in Resident Hostel & Guest House shall be through gravity from Terrace Tank except upper two floors. Upper two floors of these buildings shall be fed by hydro pneumatic system. Distribution of flushing water in all Floors shall be through gravity from terrace water tank. Capacity of hydro pneumatic system for upper two floors: Two Pumps (1 working+ 1 Standby). 2.0 LPS @ 25M. Head.
2.0	Rain Water Pipes	
2.1	Resident Hostel & Guest House	Rain Water pipes including their fittings from terraces & balconies of building shall be unplasticized Rigid uPVC rainwater pipes of minimum 110 mm dia, conforming to IS: 13592 Type B,
3.0	Fire Fighting System	Entire Fire Fighting System of Building shall be installed as per NBC-2016 and local Fire Authority Norms.
3.1	Fire Extinguishers	The sufficient qty. of portable/trolley mounted type fire extinguishers (Gas Based stored pressure type CO2 type /ABC Powder Type/ Mechanical Foam etc.) shall be provided at all levels of the building at strategic locations as per requirements, generally to follow NBC- 2016 and IS – 2190: 1992 to extinguish fire of class A, B ,C. Clean agent fire extinguishers to be provided in laboratories. All Fire Extinguishers shall be Halon Free.
3.2	Internal Hydrants	Internal Hydrant station shall comprise of: 1 No. stainless steel single headed landing hydrant valve with 80 mm dia. flange inlet and 63 mm dia with 80 mm dia CI Butter fly Valve, 1 No. swinging type First Aid hose reel in red colour drum with 36.5 mtr long and 20 mm dia heavy duty rubber hose with 20 mm dia. globe valve stop cock

		<p>& Stainless-Steel coupling & nozzle of 5mm outlet with shut off valve.</p> <p>1 No. 63mm dia. Stainless Steel branch pipe with Stainless Steel nozzle of 20 mm nominal bore outlet with instantaneous type 63 mm dia. coupling.</p> <p>1 No. fireman's axe with heavy duty insulated rubber handle.</p> <p>2 Nos. of 15 m long Non-Percolating Hose Pipe.</p> <p>1 No. MS Door Shutter made up of 16 gauge MS Sheet of 2100x1200 mm size with front glass with lock and key arrangement.</p>
3.3	Terrace Tank	RCC Terrace Fire Tank of 25000 Litres capacity shall be Provided as per NBC-2016.
3.4	Terrace Pump	Fire Pump of 900 LPM @ 35 M. Head at Terrace Fire tank is not required as per NBC-2016.
3.5	Fire Pipes	<p>Mild Steel class 'C' tubes confirming to IS: 1239/3589 shall be used in Fire Fighting System.</p> <p>All Fire Pipes shall be painted with two or more coat of postal red colour synthetic enamel paint over a coat of steel primer (Both are approved quality and make).</p>
3.6	Pipe Jointing	<p>Mild Steel Pipes up to 50 mm dia shall be jointed with forged steel threaded fittings, no welding is allowed.</p> <p>Mild Steel Pipes 65 mm & above dia shall be jointed with welding joint with standard MS heavy class Fittings.</p>
V.		Staff Residences (2 BHK & 3 BHK)
Sl. No	Item of work	Scope of Work-Staff Residences (2 BHK & 3 BHK).
1.0	Internal Sanitary, Water Supply Installations.	
1.1	EWC Assembly	<p>Wall mounted EWC with Seat Cover & dual flushing concealed cistern suitable 3/6 Litres. for (with internal fittings) & dual push plate including WC Chair Bracket, WC Connector & all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge.</p> <p>Each EWC assembly shall be with following minimum number of fittings of approved make:</p> <ul style="list-style-type: none"> • CP brass Health Faucet (01 No.) with minimum 1 metre SS braided connection hose with Wall Bracket. • CP brass Angle Valve with Wall Flange, (01 No.) • CP brass Twin Bib Cock with Wall Flange (01 No.) • CP brass Twin Robe Hooks (01 No) • CP Brass Toilet Paper Holder (1 No.)
1.2	Wash basin assembly	<p>Under counter oval / rectangular shape wash basin including all accessories complete in all respect as per approved make list, architectural drawings and direction of Engineer-in-Charge.</p> <p>Each wash basin assembly shall be with following minimum number of</p>

		<p>fittings of approved make:</p> <ul style="list-style-type: none"> • CP brass Basin Mixer (Pillar Type) for Cold & Hot Water (01 No.). • CP brass Angle Valve with Wall Flange, CP Copper Connection Pipe with Nuts & Washer (02 Nos.). • CP brass 32 mm dia. Bottle Trap (01 No.). • CP Waste Jali of required size (01 No.). • Soap Dispenser (1No. for Each Wash Basin). • CP Brass Towel Ring (1 No).
1.3	Bath Fittings Assembly	<p>Each bath assembly shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer- in-Charge:</p> <ul style="list-style-type: none"> • Concealed Mixer Diverter with concealed and exposed part for hot & cold water. (01 No.). • CP brass OH Shower rose minimum 100 mm (square/ round) with shower arm (01 No.). • CP brass Bath Spout (01 No.) • CP brass Floor Trap Jali (01 No.). • CP brass Towel Rail (01 No) • Corner Glass Shelf (01 No.) • CP brass Twin Robe Hook (01 No)
1.4	Kitchen Fittings	<p>Each kitchen area shall be with following minimum number of fittings including all accessories complete in all respect as per approved make list, architectural drawings, and direction of Engineer-in-Charge:</p> <ul style="list-style-type: none"> • Stainless steel AISI 304 (18/8) Kitchen sink as per IS 13983 with drain board with minimum size 510x1040x250mm. • CP brass sink mixture (Wall Mounted) with provision of hot & cold water (01 No.). • CP brass Bottle Trap (01 No.) • CP brass floor Trap Jali (01 No). • CP brass Angle Valve (01 No for RO unit). • CP brass bib cock long body (01 No for utility area).
1.5	Mirror	<p>Float mirror of 6 mm thickness with beveled edges above counter of each wash basin slab must be provided with 8 mm thick HDF backing and to be covered with decorative type PVC laminated beading 50 mm wide all-around the mirror.</p>
1.6	Soil, Waste & Vent Pipes and Fittings	<p>All Soil, Waste & Vent Pipes including fittings shall be Sound Insulated Mineral Reinforced 3- Layer Polypropylene (PP) Pipes exposed on walls and suspended below slabs using pre painted angle iron clamps with GI threaded rods of 10 mm dia and fixed over GI clamp (along with threaded U clamps) of minimum 3 mm thickness of appropriate size in the shafts to be fixed with appropriate capacity GI wedge type metal fasteners.</p> <p>90-degree bends to be avoided and to be provided with Y, YT, 45-degree bends and large radius bends in case of junctions, change of alignments.</p>

		<p>Sufficient cleanout plugs to be provided in each line and all traps to be provided with self-cleansing P trap/floor trap of minimum 100 mm dia. Joints of pipes to be provided with push fit joint with Rubber Ring as per manufacturer's specifications.</p> <p>Minimum dia of Soil & Waste pipe (Except Waste connection from Wash Basin, Sinks & Floor Drain) shall be 100 mm irrespective of design. Testing of joints to be conducted as per approved design & as per CPWD Specification 2019.</p> <p>Minimum dia. of Vent Pipes shall be 75 mm.</p> <p>Minimum Dia. of waste pipe from wash basin shall be 40 mm and from floor drain 63 mm.</p>
1.7	Water Supply Lines	<p>All internal water supply pipes concealed in walls shall be CPVC (SDR-11) pipes & fittings.</p> <p>All internal water supply pipes exposed on wall & terrace shall be CPVC Pipes & Fittings SDR-11 & Sch.80 Grade.</p> <p>Isolation & Control Valves shall be Provided at required location of all pipes.</p> <p>Digital Water Meter shall be installed at incoming domestic & flushing water lines at Ground Level.</p>
1.8	Hot Water Supply	Provision shall be made for storage Type Electric Geysers for Hot Water supply in staff residences,
1.9	Insulation for Hot Water Pipes	Internal Toilets- 6 mm thick Nitrile Rubber Tube Section.
1.10	Over Head Tank	<p>Provision of RCC tanks of designed capacity for supply of drinking, domestic, flushing water use including partition/ separate tank for firefighting requirement as per NBC-2016 norms.</p> <p>Minimum Capacity of OH Tanks:</p> <p>2 BHK Tower</p> <p>Fire Water Tank = 25 KL</p> <p>Domestic Water Tank = 14 KL</p> <p>Flushing Water Tank = 7 KL</p> <p>3 BHK Tower</p> <p>Fire Water Tank = 25 KL</p> <p>Domestic Water Tank = 6 KL</p> <p>Flushing Water Tank = 3 KL</p>
1.11	Water Distribution	<p>Distribution of domestic water in staff residences shall be through gravity from Terrace Tank except upper two floors. Upper two floors of these buildings shall be fed by hydro pneumatic system.</p> <p>Distribution of flushing water in all Floors shall be through gravity from terrace water tank.</p>

		Capacity of hydro pneumatic system for upper two floors: Two Pumps (1 working+ 1 Standby). 1.5 LPS @ 25M. Head.
2.0	Rain Water Pipes	
2.1	2 & 3 BHK Residences	Rain Water pipes including their fittings from terraces & balconies of building shall be unplasticized Rigid uPVC rainwater pipes of minimum 110 mm dia, conforming to IS: 13592 Type B,
3.0	Fire Fighting System	Entire Fire Fighting System of Building shall be installed as per NBC-2016 and local Fire Authority Norms.
3.1	Fire Extinguishers	The sufficient qty. of portable/trolley mounted type fire extinguishers (Gas Based stored pressure type CO2 type /ABC Powder Type/ Mechanical Foam etc.) shall be provided at all levels of the building at strategic locations as per requirements, generally to follow NBC- 2016 and IS – 2190: 1992 to extinguish fire of class A, B ,C. Clean agent fire extinguishers to be provided in laboratories. All Fire Extinguishers shall be Halon Free.
3.2	Internal Hydrants	Internal Hydrant station shall comprise of: 1 No. stainless steel single headed landing hydrant valve with 80 mm dia. flange inlet and 63 mm dia with 80 mm dia CI Butter fly Valve, 1 No. swinging type First Aid hose reel in red colour drum with 36.5 mtr long and 20 mm dia heavy duty rubber hose with 20 mm dia. globe valve stop cock & Stainless-Steel coupling & nozzle of 5mm outlet with shut off valve. 1 No. 63mm dia. Stainless Steel branch pipe with Stainless Steel nozzle of 20 mm nominal bore outlet with instantaneous type 63 mm dia. coupling. 1 No. fireman’s axe with heavy duty insulated rubber handle. 2 Nos. of 15 m long Non-Percolating Hose Pipe. 1 No. MS Door Shutter made up of 16 gauge MS Sheet of 2100x1200 mm size with front glass with lock and key arrangement.
3.3	Terrace Tank	RCC Terrace Fire Tank of 25000 Litres capacity shall be Provided as per NBC-2016.
3.4	Terrace Pump	Fire Pump of 900 LPM @ 35 M. Head at Terrace Fire tank is not required as per NBC-2016.
3.5	Fire Pipes	Mild Steel class ‘C’ tubes confirming to IS: 1239/3589 shall be used in Fire Fighting System. All Fire Pipes shall be painted with two or more coat of postal red colour synthetic enamel paint over a coat of steel primer (Both are approved quality and make).
3.6	Pipe Jointing	Mild Steel Pipes up to 50 mm dia shall be jointed with forged steel threaded fittings, no welding is allowed. Mild Steel Pipes 65 mm & above dia shall be jointed with welding joint with

		standard MS heavy class Fittings.
VI.		Under Ground Water Tanks & Pump Room
1.1	Under Ground Water Tank	<p>Capacity of RCC Water Tanks</p> <p>Fire Water Tank = 400 KL Raw Water Tank = 300 KL Domestic Water Tank = 300 KL Flushing & Irrigation Tank at STP Area = 225 KL Soft Water Tank at STP Area = 275 KL</p>
1.2	Water Supply Pumps Capacity	<p>Filter Feed Pump- 3 Nos (2 W +1 S) Capacity 13500 LPH Each @ 30 M Head.</p> <p>Softener Feed Pump - 2 Nos (1 W +1 S) Capacity 23400 LPH Each @ 30 M Head.</p> <p>Soft Water Transfer Pump- 2 Nos (1 W +1 S) Capacity 23400 LPH Each @ 60 M Head.</p> <p>VSPS Hydropneumatic System for Domestic Water Supply- 3 Nos (2 W +1 S) Capacity 19800 LPH Each @ 60 M Head.</p> <p>VSPS Hydropneumatic System for Flushing Water at STP Area- 2 Nos (1 W +1 S) Capacity 18000 LPH Each @ 60 M Head.</p>
1.3	Sump Pumps	Sump Pump- 2 Nos (1 W +1 S) Capacity 14400 LPH Each (Solid handling Capacity- 12 mm) @ 15 M Head.
1.4	Water Filter & Softener	<p>Dual Media Filter for Domestic Water Supply- 2 Nos Capacity 13500 LPH Each minimum 1150 mm dia.</p> <p>Pressure Sand Filter for Rain Water - 1 No Capacity 14400 LPH Each minimum 1250 mm dia.</p> <p>Water Softener for Soft Water- 1 No Capacity 23400 LPH Each.</p>
1.5	Fire Pumps at UGT	<p>Main Electric Fire Pumps - 2 Nos x 2850 LPM @ 90 M Head.</p> <p>Diesel Engine Driven Pumps- 2 Nos x 2850 LPM @ 90 M Head.</p> <p>Electric Jockey Pumps- 2 Nos x 180 LPM @ 90 M Head.</p> <p>MS Pressure Vessel- 2 Nos x 450 mm dia.</p>
1.6	Water Supply Pipes Within Pump Room	All Water Supply Pipes in pump room shall be uPVC Schedule-80 Pipes & Fittings as per ASTM D 1785, ASTM D 2466-67.
1.7	Fire Pipes	<p>Mild Steel class 'C' tubes confirming to IS: 1239/3589 shall be used in Fire Fighting System.</p> <p>All Fire Pipes shall be painted with two or more coat of postal red colour</p>

		synthetic enamel paint over a coat of steel primer (Both are approved quality and make).
VII.		External Plumbing & Fire Fighting Services
1.0		External Water Supply
		<p>External Water Supply system comprise of water supply pipes, valves, masonry valve chambers etc. shall be executed as per Drawings & direction of Engineer-in-charge.</p> <p>All external water supply pipe buried in ground shall be Ductile Iron (K-9) Pipes & Fittings for 100 mm and Above dia lines & CPVC Pipes & Fittings for 80 mm and below dia lines.</p> <p>All external CPVC Pipes buried in ground shall be protected with 75 mm thick all-round Coarse sand.</p> <p>Brick masonry chambers of appropriate size with FRP Cover with Frame complete as per direction of Engineer-in-charge.</p>
2.0		Deleted
3.0		Sewerage & Effluent System
		<p>Design Parameters- 80% of Domestic Water & 100% of Flushing Water Requirement.</p> <p>Sewerage System shall be executed as per Drawings & direction of Engineer-in-charge.</p> <p>All Sewerage Lines from GT to Manhole & Manhole to Manhole shall be HDPE DWC pipe SN 8 Grade conforming to IS 16098.</p> <p>Cement concrete 1:4:8 (1 cement: 4 coarse sand: 8 graded stone aggregate 40mm nominal size) for 150 mm thick bed of HDPE DWC pipes shall be provided as per standard design of CPWD specifications.</p> <p>Minimum dia of pipe between GT and Manhole shall be 150 mm.</p> <p>Minimum dia of pipe between Manhole and Manhole shall be 200 mm.</p> <p>Grease Trap of required capacity Shall be provided for Hospital & Hostel Kitchens.</p> <p>The Gully Traps shall be constructed of brick masonry with SFRC Manhole Cover & Frame as per CPWD specifications and National Building Code.</p> <p>The Manholes shall be constructed of requited size and shape in pre cast / cast-in-situ RCC as per Structural GFC Drawings in the required gradient and depth with SFRC Manhole Cover & Frame as per CPWD specifications</p>

		and National Building Code. Note: Orange colour safety foot rest of minimum 16mm thick plastic encapsulated to be provided complete as per IS: 10910.
4.0		Sewage Treatment Plant
		Sewage Treatment Plant Capacity = 485 + 20% as per MoEF = 485 + 97 =582 KLD, Say 600 KLD. Effluent Treatment Plant Capacity = 60 KLD for Hospital. Sewage Treatment Plant Technology = Membrane Bio Reactor (MBR) Technology. Reuse of Treated Effluent = In Flushing, Landscape Irrigation & Cooling Tower Make up. Note: The EPC contractor shall construct civil work for 600 KLD STP & Electro-mechanical equipment shall be execute for 415 KLD Capacity in modular manner.
5.0		Storm Water Drainage System
		Design Parameters- Rain Fall Intensity = 100 mm/Hr Minimum Size of Channel = 450 X 450 mm. Minimum dia of pipe shall be 250 mm. Storm Water Drainage System shall be executed as per Drawings & direction of Engineer-in-charge. All Storm Water Drainage Lines shall be RCC NP-2 Pipes conforming to IS 458. Cement concrete 1:4:8 (1 cement: 4 coarse sand: 8 graded stone aggregate 40mm nominal size) up to haunches of RCC pipes including bed shall be provided as per standard design of CPWD specifications. The Manholes & Road Gully Chambers shall be constructed of RCC / pre cast RCC with SFRC Manhole Cover & Frame as per GFC drawings. Note: Orange colour safety foot rest of minimum 16mm thick plastic encapsulated to be provided complete as per IS: 10910.
6.0		Rain Water Harvesting System
		Rain Water Harvesting System shall be executed as per Drawings & direction of Engineer-in-charge. The rainwater from the terraces of buildings shall be collected in the RCC

		<p>Rain Water Collection Tanks through catch basins & RCC chambers/ Manholes with RCC NP-2 Pipes network. A desilting chamber shall be provided before rain water collection tank. Rain Water from collection tanks shall be transfer to Raw Water tank after filtration for reuse.</p> <p>The rainwater from the open surface areas of our site and over flow from Rain Water collection tanks will be taken out from our premises through catch basins & RCC chambers / Manholes with RCC NP-2 Pipes network.</p>
7.0		External Fire Fighting System
		External Fire Fighting system comprise of Excavation, Fire Fighting Piping, Pipe Protection, valves, masonry valve chambers, External Fire Hydrant, Fire Brigade Connection, Draw off connection etc. shall be executed as per NBC-2016, Fire Fighting Drawings & direction of Engineer-in-charge.
7.1	Fire Pipes	All pipes used for External Fire Works (underground) shall be Ductile Iron Pipes (K-9) conforming to IS : 8329, including DI fittings class K-12 conforming to IS : 9523 suitable for push-on-joints or mechanical jointing.
7.2	Pipe Jointing	Ductile Iron Pipes shall be suitable for push-on-joints. Wherever required mechanical jointing also provided.
7.3	Fire Brigade Connection	02 Nos. Fire brigade connection of cast iron body with gun metal male instantaneous inlet couplings complete with cap and chain conforming to IS 904 for UG Fire Tank & Fire Pumps Delivery Header.
7.4	Draw Off Connection	01 No. gun metal fire Brigade Suction Hose coupling (Draw-out Connection) as per IS:902- 1974 completes with 100 mm dia. G.I. Suction pipe and 100 mm dia. 1No. C.I. Foot valve for UG Fire Tank.
7.5	External Fire Hydrant	<p>External Fire Hydrant shall be comprising of:</p> <p>1 No. stainless steel single headed landing hydrant valve with 80 mm dia. flange inlet and 63 mm dia with 80 mm dia CI Butter fly Valve,</p> <p>1 No. 63mm dia. Stainless Steel branch pipe with Stainless Steel nozzle of 20 mm nominal bore outlet with instantaneous type 63 mm dia. coupling.</p> <p>2 Nos. of 15 m long controlled Percolating (CP) Hose Pipe.</p> <p>1 No. Weather proof hose cabinets fabricated from 14 g M.S. Sheet with full glass door and mortise locking arrangement. The cabinet shall be painted with one coat of primer and finished stove enameled "Fire Red", "Fire Hose" written on front (Approx 0.75mx0.6 m x 0.25 m).</p>

NIT No- AGIHF/Executing Agency/2024-25/01 date 27.08.2024

PART - C

**PARTICULAR SPECIFICATION FOR PLUMBING &
FIRE-FIGHTING WORKS**

1. Plumbing Works

- Sanitary Fixtures & C.P Brass Fittings
- Soil, Waste, Vent, Pipes & Fittings
- Water Supply System
- Sewerage System
- Storm Water Drainage System
- Water Supply & Drainage Pumps.
- Water Treatment Equipment's.
- Effluent Treatment Plant.
- Sewage Treatment Plant.

2. Fire Fighting Works

- Fire Hydrant System
- Fire Sprinkler System
- Fire Pump & Accessories
- Fire Extinguishers
- Gas Flooding System for Server Room, UPS Room, MRI, CT scan.

3 Execution of work

- 3.1 The work shall be carried out in conformity with the Plumbing & fire fighting drawings and within the requirements of architectural, HVAC, electrical, structural and other specialised services drawings.
- 3.3 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule. All supports to the civil structure shall be provided with dash fasteners as per approved make only.

4 Drawings

- 4.1 Contract drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings.
- 4.2 Architectural drawings shall take precedence over plumbing or other services drawings as to all dimensions.
- 4.3 Contractor shall verify all dimensions at site and bring to the notice of the Engineer-in-Charge all discrepancies or deviations noticed. Decision of the Engineer-in-Charge shall be final.
- 4.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.
- 4.5 Any drawings issued by the Architects/Consultant for the work are the property of the Architects/ Consultant and shall not be lent, reproduced, or used on any works other than intended without the written permission of the Architects/Consultant.

6 Metric Conversion

- 6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

- 6.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

7 Reference Points

- 7.1 Contractor shall provide permanent bench marks, flag tops and other reference points and check that with other agencies to confirm the same reference point for all the proper execution of work and these shall be preserved till the end of the work.
- 7.2 All such reference points shall be in relation to the levels and locations, given in the architectural and plumbing drawings.

8 Reference Drawings

- 8.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All-important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.
- 8.4 Shop drawings are detailed working drawings which incorporate the contractor's details for execution of the work and incorporate equipment manufacturer's details and dimensions to ensure that the same can be installed in the space provided.
- 8.5 All shop drawings should detailed pipe routing and levels, showing location of other services at crossings etc., cable runs, route cable trays and all allied works and must be fully co-ordinated with other services and approved by the Engineer-in-Charge before execution of the works. Engineer-in-Charge shall arrange to issue two copies/prints of services drawings from the respective contracting agencies. **All drawings will be valid only when stamped and issued by the Engineer-in-Charge.**
- 8.6 Shop drawings shall also be furnished for detailed layout of all equipment, foundation, bolting and vibration elimination details along with information on dead and dynamic load, vibration etc.
- 8.8 Contractor shall submit shop drawings furnishing all details of MCC panels, cable routes, wiring diagrams and connection details as required.
- 8.10 Each submission shall be accompanied by contractor's certificate stating that the shop drawings meet all the contract requirements and that the piping and equipment can be satisfactorily installed without any obstructions in the space available.

10 Testing

- 10.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.
- 10.2 Tests shall be performed in presence of the Engineer-in-Charge and test records for the tests shall be duly signed by Plumbing Consultant, Contractor and the Engineer-in-Charge.

- 10.3 All materials and equipment found defective shall be replaced at contractor cost and whole work shall be tested to meet the requirements of the specifications.
- 10.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet municipal or other bye-laws in force.
- 10.5 Contractor shall provide all labour, equipment and materials for the performance of the tests at no extra cost.

13 Cutting of Water Proofing Membrane:

No walls terraces shall be cut for making and opening after water proofing has been done without written approval. Cutting of water proofing membrane shall be done very carefully so as other portion of water proofing is not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully water proof as per specifications and details of water proofing approved by Engineer-in-Charges. Actual cost of any damage to finished work by contractor shall be recovered from Plumbing Contractor.

14 Cutting of Structural Members

No structural member shall be chased or cut without the written permission of the Engineer- in-Charge. Any damage to the structure shall be on contractor's account.

2 General Requirements

- 2.1 All Sanitary Ware & C.P Brass Fittings shall be low flow rate fixtures to confirm the GRIHA-3 Standards.
- 2.2 The contractor shall be identifying the quantity of sanitary fixtures and fittings as per the drawing.
- 2.3 Sanitary fixtures shall be of the best quality approved by the Architect / Consultant / Engineer-in-Charge / Client. Wherever particular makes are mentioned, the choice of selection shall remain with the Architect / Consultant / Engineer-in-Charge / Client.
- 2.4 All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the DBR, specifications, drawings. Accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connection pieces.
- 2.5 Fixing screws shall be half round head chromium plated brass screws with C.P. washers where necessary.
- 2.6 Contractor shall furnish without cost all such accessories and fixing devices that are necessary and required but not supplied along with the Plumbing Fixtures & CP Fittings by the manufacturers as a part of the original and standard supply.
- 2.7 All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.
- 2.8 Contractor seal all fixtures fixed near wall, marble and edges. With an approved type of poly-sulphide sealant appropriate for its application.

3 European W.C

- 3.1 European W.C. shall be wash down or symphonic type wall mounted set flushed by means of dual flush Cistern systems which will be an integral part of the wall system. **Framework, walling and finishing will not form a part of the contractor's work.** Where applicable flush pipe / bend shall be connected to the W.C. by means of a suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair.
- 3.2 Each W.C. set shall be provided with a plastic seat shall be with rubber buffers and chromium plated hinges.
- 3.3 Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Each W.C. shall be suitable for flushing in low volume of water 2-4 litres.
- 3.4 Flushing Cistern shall be provided with all internal flushing mechanism, 15 mm dia ball cock with unbreakable polythene float and overflow pipe. Any frame work required for fixing cistern has to be provided by the contractor.

3.5 Indian W.C

- 3.5.1 Indian water closet squatting pan (Indian type W.C. pan) with 100 mm sand cast Iron P or S trap, 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever) conforming to IS : 7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required.
- 3.5.2 Flushing Cistern shall be provided with all internal flushing mechanism, 15 mm dia ball cock with unbreakable polythene float and overflow pipe.

3.6 Lavatory basin

- 3.6.1 Lavatory basins shall be white glazed vitreous china of size, shape and type as shown in the drawings.
- 3.6.2 Each basin shall be provided with brackets and clips of approved and securely fixed. Placing of basins over the brackets without secure fixing shall not be accepted.
- 3.6.3 Each basin shall be provided with 32 mm dia C.P. waste with overflow, pop-up waste or rubber plug and chain, 32 mm dia C.P. brass bottle trap with C.P pipe to wall and flange as specified in the Scope of work/ GFC drawings.
- 3.6.4 Each basin shall be provided with single lever basin Mixer / pillar faucet as specified in the specification.
- 3.6.5 Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms or as directed by Engineer-in-Charge.

3.7 Sinks

- 3.7.1 Sinks shall be white glazed fireclay or vitreous china or stainless steel or any other material as specified in the Drawings.
- 3.7.2 Each sink shall be provided with brackets of approved and securely fixed. Counter top sinks shall be fixed with suitable brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug as given in the Bill of Quantities. Fixing shall be done as directed by Engineer-in-Charge.

3.7.3 Sinks shall be provided with sink mixer as specified in the specifications / DBR/Drawings.

3.8 Toilets for Disabled

3.8.1 Where specified in washroom facilities designed to accommodate physically handicapped, accessories should be provided as directed by the Engineer-in-Charge.

3.8.2 Stainless steel grab bars of required size suitable for concealed or exposed mounting and non-slip gripping surface shall be provided in all washrooms to be used by physically handicapped as directed by the Engineer-in-Charge.

3.9 Shower set

3.9.1 Shower set shall comprise of single lever divertor, C.P. shower arm with wall flange, shower head and bath spout & hand shower of approved quality or as specified in the Bill of Quantities.

3.9.2 Shower mixer and shower arm shall be so fixed as to keep the wall flange clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

3.10 Urinals

3.10.1 Urinals shall be white glazed vitreous china of size, shape and type specified in the drawings / specifications.

3.10.2 Bowl urinals shall be provided with 15 mm dia C.P. spreader, 40 mm dia stainless steel domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by C.I. brackets and C.I. wall clips as recommended by manufacturers complete as directed by Engineer-in-Charge.

3.10.3 Urinals shall be fixed with SS screws and shall be provided with 32 mm dia domical waste leading to urinal's trap.

3.10.5 Urinals shall be provided with integrated sensors flushed by means of fully automatic.

3.10.6 Waste pipes for urinals shall be Polypropylene (PP) Pipe. Waste pipes may be exposed on wall or concealed in chase as per the drawing or directed by the Engineer-in-Charge.

3.11 Urinal Partitions

3.11.1 Urinal partitions shall be 12mm thick HPL board /frosted glass fixed with SS fittings.

3.12 Accessories

3.12.1 Contractor shall install all chromium plated and porcelain accessories as shown on the drawings or directed by the Engineer-in-Charge.

3.12.2 All C.P. accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by Engineer-in-Charge.

- 3.12.3 Recessed porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work as per Architect /Interior Designer's drawings.

3.13 Final Installation

The contractor shall install all sanitary fixtures and fittings in their position in accordance with approved trial assemblies and as shown on drawings. The installation shall be completed with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal/replacement of sanitary fixtures without disturbing the built-in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and to alignment. The outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. It shall be ensured that the receiving pipes are clear of obstruction. When fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that the necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

Soil, Waste, Vent & Rainwater Pipes & Fittings

3 Piping System

3.1 Schedule of Pipes Use

1.	Polypropylene (PP) Pipes and Fittings Waste Pipes.	Horizontal	Soil &
2.	Polypropylene (PP) Pipes and Fittings	Vertical	Soil, Waste. Stacks up to GT/MH.
3.	Polypropylene (PP) Pipes and Fittings from WB, & FD.	Waste	Connection
4	HDPE & uPVC Pipes (6 kg/cm ²) Conforming to IS: 4985, System.	For Rain Water	System.

3.2 Soil, Waste & Vent Pipes

- a) The Soil & Waste Pipe System above ground has been planned as a "two pipe system" as defined in IS: 5329 having separate pipes for waste for kitchen sinks, bath tubs, showers, washbasins, condensate drains and floor drains and is approved by Engineer-in-Charge.
- b) Vertical soil & waste stacks shall be connected to a horizontal Soil and Waste Pipe as shown on the drawings.
- c) Toilet layouts have been so arranged that the W.C. outlets shall be with "P" trap above ground.

3.3 Polypropylene Pipes (PP) Soil, Waste & Vent Pipes

- a) All Polypropylene Pipes shall be sound-insulating mineral reinforced 3-layer polypropylene pipe Conforming to 12056, DIN EN752, DIN1986-100, and DIN EN1610. Tensile strength of the pipes is DIN EN accordance to DIN EN ISO 527-3. The pipe connections are leak-proof up to an internal excess water pressure of 1.0 bar. Fire behaviour for the system is in accordance with EN 13501-1, D,S3-d0 Fulfils the requirements of VDI guideline 4100 with excellent results (less than 20 db. Installation sound level measured.).
- b) All pipes shall be straight and smooth from inside free from irregular bore, blow holes, cracks and other manufacturing defects.

3.4 Fittings

- 3.4.1 Fittings shall conform to the same Standard as for pipes. Pipes and fittings must be of matching Specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.
- 3.4.2 Fittings shall be of the required degree of curvature with or without access door.

3.5 Jointing

3.5.1 Jointing of Pipes

- 3.5.2 All Polypropylene (PP) Pipes shall be jointed push fit joints.

- 3.5.3** All uPVC pipes & Fittings shall be jointed with solvent cement as per manufacturer's specifications and relevant I.S codes.
- 3.5.4 All pipes shall be tested after installation for a pressure equal to twice the maximum working pressure in the line as per manufacturer's specifications.

3.6 uPVC Rain Water Pipes

- a) All Rain Water Pipes used in building shall be uPVC pipes (6kg/cm²) as specified below.
- b) All pipes shall be straight and smooth from inside free from cracks and other manufacturing defects.
- c) uPVC Pipes & Matching Fitting shall be conforming to IS 4985 or BS: 4514.

3.7 Fixing

- 3.7.1 All vertical pipes shall be fixed by **Galvanised** clamps and galvanised angle brackets truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).
- 3.7.2 Horizontal pipes running along ceiling shall be fixed on galvanised structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.
- 3.7.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

3.8 Clamps

- 3.8.1 All pipe clamps, supports and hangers shall be galvanised. Factory made Pre-fabricated clamps shall be preferred. Contractor may fabricate the clamps of special nature and galvanise them after fabrication but before installation. All nuts, bolts, washers and other fasteners shall be factory galvanised.
- 3.8.2 Clamps shall be of approved designs and fabricated from GI flats (which shall be galvanised after fabrication) of thickness and sizes as per drawings or contractor's shop drawings. Clamps shall be fixed in accordance to manufacturer's details/shop drawings to be submitted by the contractors.
- 3.8.3 When required to be fixed on RCC columns, walls or beam they shall be fixed with approved type of galvanised expansion anchor fasteners (Dash fasteners) of approved design and size according to load.
- 3.8.4 Structural clamps e.g. trapeze or cluster hangers shall be fabricated by electro-welding from M.S. Structural members e.g. rods, angles, channels flats as per Contractors shop drawing shall be galvanised after fabrication. All nuts, bolts and washers shall be galvanised.
- 3.8.5 Galvanised slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on

drawings or specified in Bill of Quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with anchor fasteners mentioned above. The spacing of support bolts on support members fixed horizontally shall not exceed 1 m.

3.9 Traps

3.9.1 Floor Traps

Floor traps where specified shall be siphon type full bore P or S type Polypropylene (PP) having a minimum 50 mm deep seal. The trap and waste pipes when buried below ground shall be set and encased in cement concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size).

Contractor shall provide all necessary shuttering and centring for the blocks. Size of the block shall be 30x30 cms of the required depth.

3.9.2 Floor Trap Inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type of floor or manhole inlet fitting fabricated from G.I. uPVC pipe without, with one, two or three inlet sockets welded on side to connect the waste pipe or joint between waste and inlet socket shall be Drip Seal. Inlet shall be connected to a C.I. P or S trap. Floor trap inlet and the traps shall be set in cement concrete blocks where varied in floors as specified without extra charge. Floor trap for the shower cubicle shall suit site and as per the approval of Engineer-in-Charge.

3.9.3 Floor Trap Grating

Floor and urinal traps shall be provided with 100 -150mm square or round Stainless-Steel gratings as approved with frame and rim of approved design and shape or as specified in the Bill of Quantities approved by the Engineer-in-Charge.

3.10 Cleanout plugs

Clean out plug for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor levels. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be Cast Brass suitable for the Pipe dia. With screwed to a G.I. socket. The socket shall be lead caulked to the drain pipes.

3.11 Waste Pipe from Appliances

3.11.1 Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of Polypropylene Pipes (PP) in typical Toilets kitchens, pantries, and equipment's and service areas where so required, and as shown on the drawings.

3.11.2 All pipes shall be fixed in gradient towards the connection to stack or drains. Pipes inside all toilets shall be in chase unless otherwise shown on drawings. Where so required and shown on drawings or directed by the Engineer-in-Charge.

3.12 Encasing in Cement Concrete

3.12.1 Encasing of pipes is required to provide stability to the line and prevent its damage during construction.

a) CI soil and waste pipes under floor

Pipes lay in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 12 mm size) 75 mm in bed and all round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8 m.

3.12 Cutting and making good

3.12.1 Contractor shall provide all holes cut outs and chases in structural members necessary and required for the pipe work as building work proceeds. Wherever cut outs , holes are left in the original construction, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

3.13. Sleeves/ Cut-Outs.

3.13.1 Contractor shall utilised all cut out and sleeves provided during construction to prevent breaking. The annular space between the pipe and the sleeve shall be filled up with approved type of fire-retardant sealant. When sleeves are misplaced or inaccurately located contractor shall make the holes in the wall or structural members at his own cost but only with the prior permission of the Engineer-in-Charge.

Water Supply System

3.1.1 Contractor should study the site plan and water supply system diagram for an overview of the system.

3.1.2 It is proposed to provide dual flushing cistern for all WCs.

4.0 CPVC Pipes, Fittings

All cold & hot water pipes inside the toilet (Concealed in wall or in false ceiling) shall be CPVC pipes SDR 11 conforming to IS 15778.

4.1 Materials

4.1.1 All pipes and fitting comply with IS 15778 standard.

4.1.2 CPVC fusion compound (solvent cement) as per ASTM F493.

4.1.3 All fitting is fusion bonding type (assembly using CPVC fusion compound) unless otherwise specified.

4.1.4 All metal transition is brass type with threads as per IS 554CPVC threaded fitting are not recommended.

4.2 Installation

- 4.2.1 Install product according to Ajay's installation instruction and manual and follow recommended safe works practices.
- 4.2.2 Keep pipe and fitting in original packaging until needed and store pipes in covered areas.
- 4.2.3 Use tools designed for use with plastic pipe and fitting.
- 4.2.4 Cut of minimum 25mm beyond the edge of the crack in case any crack is discovered in the pipe.
- 4.2.5 Cut the pipe as square (perpendicular) as possible before making joint. Always use sharp edge cutting tools. Sharpen holder tools periodically.
- 4.2.6 Always apply a heavy & even coat of CPVC solvent cement on pipe and a light coat inside fittings.
- 4.2.7 Use CPVC fusion compound conforming with ASTM F 493.
- 4.2.8 Always hold the fresh fusion compounded joint in place for 20-30 second.
- 4.2.9 Use brass threaded MTA's and FTA's for hot water & for transition to or from Metal.
 - 4.2.10 Always conduct hydraulic pressure testing after installation to detect any leaks and faults. Wait for appropriate cure time before pressure testing. Fill lines slowly and bleed air from the system prior to pressure testing.
- 4.2.11 Deburr, bevel and clean mating surface of pipe and fittings before joining.
 - 4.2.12 Rotate the pipe 80 degree to 190 degree to spread the CPVC solvent cement evenly in the while pushing the pipe into fitting.
- 4.2.13 Use Teflon tapes with threaded fitting.
- 4.2.14 Ensure that there no sharp edge in contact with the pipe while embedding the pipes on the wall or in the floors.
- 4.2.15 Provide vertical and horizontal supports as recommended using the plastic straps only.
- 4.2.16 Apply only water- based paint on exposed pipes and fitting.
- 4.2.17 Provide sleeves (pipe cover) at entry & exit it under slab installations & while crossing walls. Visually inspect all joints for proper cemented at the end of shift or day. A visual inspection of the complete system is also recommended during pressure testing.

5.0 G.I. Pipes & Fittings

- 5.1.1 Pipes shall be galvanised steel tubes conforming to I.S. 1239 of Medium Class as specified in Scope of work / GFC Drawings.
- 5.1.2 Fittings shall be malleable galvanised iron and shall have manufacturer's trade mark stamped on it. Fittings for G.I. pipes shall include couplings, tees, reducers, nipples, unions, bushes. Fittings shall conform to I.S.1879-(Part I to X).

- 5.1.3 Pipes and fittings shall be jointed with screwed joints. Care shall be taken to remove burr from the end of the pipe after reaming with a proper time.
- 5.1.4 Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply.
- 5.1.5 All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall be fixed in wall chases well above the floor. No pipes be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings.

6.0 Stainless Steel – 316 Grade Pipe and Fittings

The pipes shall be Stainless Steel 316 pipes confirming to requirements of DIN-EN 10088 and the press fittings shall confirm to DVGW and Material No. 1.4404 for Press Connection system with leak before pressed function **(LBP)** showing penetration of water at the unpressed connection while filling the installation. The system should withstand working pressure of 16 bars at 30 degree centigrade and should withstand temperature of 110 degree centigrade should be doubly secured locking system.

The fittings shall be as follows:

Doubly secure Press fittings with leak before pressed function (LBP) for pipes from 15mm to 108 mm dia.

Technical Data

Stainless steel pipes - thin-walled and corrosion resistant stainless steel pipes.

Material no. 1.4401 (X5 CrNiMo 17-12-2)

Black; EPDM (ethylene propylene diene rubber); up to 110 °C;

Not resistant to hydrocarbon solvents, chlorinated hydrocarbons, turpentine, petrol.

Bars 3/6 m in length, with bright-finished external and internal surfaces

Plastic plugs on pipe ends

All pipes are leak-tested and marked as such Pipe material no. 1.4401:

DVGW approval: Worksheet GW541

d x s [mm]	Volume per cons. metre of pipe [Liter/m]	Weight per cons. metre of pipe [kg/m]	Weight per 6 m length [kg]	Size	Material Press connector
15 x 1.0	0.13	0.35	2.10	Standard	Stainless steel
18 x 1.0	0.20	0.43	2.55		
22 x 1.2	0.30	0.65	3.89		
28 x 1.2	0.51	0.84	5.02		
35 x 1.5	0.80	1.26	7.55		
42 x 1.5	1.19	1.52	9.13		
54 x 1.5	2.04	1.97	11.83		
76.1 x 2.0	4.08	3.70	22.20	XL	Stainless steel
88.9 x 2.0	5.66	4.34	26.00		
108.0 x 2.0	8.49	5.30	31.80		

Fixing intervals

Pipe clamps suitable for SS pipes with protective inserts can be used.

Pipe Sizes	Interval [m]
15	1.25
22	2.00
28	2.25
35	2.75
42	3.00
54	3.50
76	4.00
88.9	4.00
108	4.00

Making the press connection

Metal pipes 12 – 54 mm

The press connection provides an easy and reliable means of connecting stainless steel and copper pipes. To make this connection, you will need Pipe cutters or a fine-toothed steel saw De-burrer and coloured pen to mark the insertion depth Certified press tool with press jaw suitable for pipe diameter

64.0 – 108.0 mm

The press connection provides an easy and reliable means of connecting stainless steel pipes. Pipe cutters or fine-toothed steel saw De-burrer and coloured pen for marking Viega press tool with press jaw suitable for pipe diameter Place the hinged tension jaw on the press tool and push in the retaining pin until it snaps into place.

7.0 Valves

All Valves shall be forged brass ball valve or CI butterfly valve as per GFC drawings.

8.0 Pipe Supports

- 8.1 All pipes’ clamps, supports, hangers, rods, pipe supports, nuts bolts & washers shall be factory made galvanised or alternatively galvanised after fabrication to suit site requirements.
- 8.2 Stainless Steel Pipes in shafts and other locations shall be supported by galvanised clamps of design approved by Pipes in wall chases shall be anchored by G.I. hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. Structural. Pipes in typical shafts shall be supported on Galvanised slotted angles/channels as specified elsewhere.

9.0 Anchor Fasteners

- 9.1 All pipes support, hangers, and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the owner for any damage that may be caused by such failures.

10.0 Unions

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-Charge.

11.0 Flanges

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by Connections shall be made by the correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve to I.S. 780. And C.I. butterfly valve to IS: 13095.

12.0 Trenches

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows: -

Dia of pipe trench	Width of trench	Depth of
15 mm to 50 mm	30 cms	75 cms
65 mm to 100 mm	45 cms	100 cms

13.0 Sand filling

CPVC / G.I Pipes in trenches shall be protected with fine sand 15 cms all round before filling in the trenches.

14.0 Painting

14.1 All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code given in these documents or specified by Consultant/Engineer-in-Charge.

15.0 Pipe protection

15.1 All GI in wall chase and below floor in toilets (where so fixed) shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.

15.2 G.I. waste pipes buried in ground or sunken slab shall be protected with multi-layer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. "Pypkote" or equivalent.

16.0 Insulation

16.1 All hot water pipes shall be insulated with elastomeric closed shells circular pipes.

16.2 All insulation material shall be elastomeric closed shells Nitrile Rubber has a high diffusion resistance factor that prevent excessive water diffusion that gives longer lifetime of material.

16.3 The insulation material having the property of resistance of fire i.e. in case of fire these materials do not drop and do not spread flames.

16.4 All insulation material as per din 1988/7 (standard for drinking water pipe installation and for avoiding corrosion damage and scale formation).

16.5 The thermal conductivity of material at 0 deg. C = 0.038 w/(m.K).

16.6 The temperature resistance of material between - 40 Deg C to +105 Deg C.

16.7 The Thickness of insulation pipes as follows:

Size of pipes	Application of pipes	Location	Thickness of Material (mm)	Type of Section	Density of Insulation	Insulation Protection
15 mm to 40mm	Hot water supply & Return	Concealed	6 mm	Nitrile Rubber Tube Section	40 Kg/Cum	-
15 mm to 100 mm	Hot water supply & Return	Exposed in Shafts	9 mm	Nitrile Rubber Tube Section	40 Kg/Cum	IC Clad covering (reinforced glass fibre fabric)
15 mm to 100 mm	Hot water supply & Return	Exposed at Terrace	13 mm	Nitrile Rubber Tube Section	60 Kg/Cum	24-gauge aluminium cladding,

17.0 Valves

17.1 Ball Valves

Valves upto 40 mm dia. shall be screwed type Ball Valves with stainless steel balls, spindle, Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm², and accompanying couplings and steel handles.(to BS 5351)

17.2 Butterfly Valves

17.2.1 Valves 50 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

17.2.2 Butterfly valve shall be of best quality conforming to IS: 13095.

17.3 Non-Return Valve (Slim Type)

Where specified non-return valve (dual type check valve) shall be provided through which flow can occur in one direction only. It shall be single door swing check type of best quality.

17.3.1 Each Butterfly and dual plate Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanised nuts, bolts and washers of correct length.

18.0 Water Meters

Water meters of approved make and design shall be supplied for installation at locations as shown. The water meters shall meet with the approval of local supply authorities. Suitable valves and masonry chambers with FRP cover with frame to be provided along with the meters.

The meters shall conform to Indian Standard IS:779 and IS:2373. Calibration certificate shall be obtained and submitted for each water meter.

21.0 Lawn Hydrants

Lawn hydrants shall be of 25mm size unless otherwise indicated. All hydrants shall be provided with gate valves and threaded nipple to receive hose pipes. Lawn hydrant valves shall be of approved make and design. Where called for lawn hydrants shall be in masonry chambers with FRP cover with frame of appropriate size.

23.0 Masonry Chamber

- i. All masonry chambers for stop cocks, sluice valves and meter etc. shall be built as per supplied drawings.
- ii. The excavation for chambers shall be done true to dimension and level indicated on plans or as directed by the Engineer-in-charge.
- iii. Concrete shall be of cement concrete 1:5:10 (1 cement: 5 coarse sands: 10 graded stone aggregate 40 mm nominal size).
- iv. Brick shall be of class designation 75 in cement mortar 1:4 (1 cement: 4 fine sand)
- v. Inside Plastering not less than 12 mm thick shall be done in cement mortar 1:3 (1 cement: 3 fine sand) finished with a floating coat of neat cement.
- vi. FRP cover with frame shall be provided for all valve chambers.

Sewerage and Drainage system

5.1 Excavation

5.1.1 Alignment and grade

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Engineer-in-Charge.

5.1.2 Opening out trenches

In excavating the trenches, etc. The solid road metaling, pavement, Kerbing, etc. And turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully sifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Engineer-in-Charge.

The Contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Engineer-in-Charge.

5.1.3 Obstruction of roads

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Engineer-in-Charge.

5.1.4 Removal of filth

All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and removed to a suitable place to be provided by the Contractor.

5.1.5 Excavation to be taken to proper depths

The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating thereto and so that the inverts may be at the levels given in the sections.

5.1.6 Refilling

After the sewer or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The back filling up to 75 cms above the crown of the sewer pipe shall consist of the finest selected materials placed carefully in 15 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15 cms layers with materials

taken from the excavation, each layer being watered to assist in the consolidation unless the Engineer-in-Charge.

5.1.7 Contractor to restore settlement and damages

The Contractor shall, at his own costs and Charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also, at his own expense and Charges, repair and make good any damage done to buildings and other property. If in the opinion of the Engineer-in-Charge.

5.1.8 Width of trench

Recommended width of trenches at the bottom shall be as follows:-

100 mm dia pipe	55 cms
150 mm dia pipe	55 cms
225-250 mm dia pipe	60 cms
300 mm dia pipe	75 cms
400 mm dia pipe	80 cms
600 mm dia pipe	100 cms

5.2 HDPE Double Wall Corrugated Pipes for Sewerage System

5.2.1 HDPE pipes shall be double wall corrugated (DWC) conforming to IS: 16098 & Jointing pipes and fittings shall be rubber ring.

5.2.2 Laying and jointing of HDPE pipes

- a) Pipes are liable to be damaged in transit and not withstanding tests that may have been made before dispatch each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.
- b) The pipes shall be laid with sockets leading uphill and rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.
- c) Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete at the Contractor's cost and Charges.

- d) If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed to ensure even bearing.

5.3 Gully traps

- a) Gully traps shall be of the same quality as described for stoneware pipes in clause 5.2 above and used where shown on drawings.
- b) Gully traps shall be fixed in cement concrete 1:4:8 mix and a brick masonry chamber 30x30 cms inside in cement mortar 1:5 with 15x15 cms grating inside and 30x30 cms C.I sealed cover and frame weighing not less than 7.0 kg (approx.) to be constructed as per standard drawing.

5.4 Reinforced cement concrete pipes

- 5.4.1 All underground storm water drainage pipes and sewer lines where specified shall be centrifugally spun S & S RCC pipes of NP2 / NP3 class. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work.

- 5.4.2 Laying R.C.C. spun pipes shall be laid on cement concrete bed as specified and shown on the detailed drawings.

5.4.3 Jointing

After setting out the pipes the socket shall be centered over the spigot and filled with cement mortar 1:1 (1 cement: 1 fine sand) and caulked by means of proper tools. All joints shall be finished at an angle of 45 degrees to the longitudinal axis of the pipe.

5.5 Manholes and Chambers

- 5.5.1 All manholes, chambers and other such works as specified shall be constructed in precast/cast-in-situ Reinforced Cement Concrete as per Structural Consultants GFC Drawings.

- 5.5.2 All manholes and chambers, etc. shall be supported on base of cement concrete of such thickness and mix as per Structural Consultants GFC Drawings.

- 5.5.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix. The benching shall have a slope of 10 cms towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement. (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal Size) as per standard details.

- 5.5.4 All manholes with depths greater than 0.75 m. shall be provided with plastic coated catch rings set in cement concrete vertically and staggered.

- 5.5.5 All manholes shall be provided with steel Fibre reinforced plastic (SFRC) covers and frames and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be as specified in the GFC Drawings/Detailed Scope of Work.

- 5.6. Cement concrete for pipe support

- a) Wherever specified or shown on the drawings, all pipes shall be supported in bed all round or haunches. The thickness and mix of the concrete shall be given in the GFC Drawings.
- b) Unless otherwise directed by the Architect/ Engineer-in-Charge cement concrete for bed, all around or in haunches shall be laid as follows: -

	Upto 1.5 m	Upto 3 m	Beyond 3 m	
		Depth	Depth	Depth
Stoneware pipes In open ground (No sub soil Water)		all round (1:4:8)	in haunches (1:4:8)	all round (1:4:8)
R.C.C or SW In sub soil Water		All round (1:3:6)	in haunches (1:3:6)	in haunches (1:3:6)
C.I. Pipes (In all Conditions)		All round (1:3:6)	in haunches (1:3:6)	in haunches (1:3:6)
R.C.C. Pipes		All around (1:4:8)	all around (1:3:6)	all around (1:3:6)

(Ratio refer to cement: coarse sand: stone aggregate 40 mm nominal size)

Water Supply & Drainage Pumps

Specifications for Pumps

3. Variable Speed Pumping System for Water Supply Systems

- 3.1 Water supply pumping system for the building shall be fully automatic variable speed drive system, packaged skid mounted system with vertical centrifugal pumping sets and arranged in a manner to operate the entire system between pre-determined operating conditions specified. Pumps shall be protected against running dry by providing low level electronic cut off switch separately for system selected. The system will be provided with an integral programmable sequence controller so that each pump operates sequentially and no single pump remains idle. The system will also be provided with stainless steel vessel of capacity as per manufacturer's recommendations with timing mechanism to ensure that each pump operates for a minimum period of one minute between two starts. Pumps shall have a pump head / efficiency curve to operate within the range given in the specifications. The pumps selected shall be suitable for continuous duty operating.
- 3.2 All systems offered will be complete packaged systems comprising of the pumps, stainless steel vessels, variable speed control systems, sensors, pressure gauges and switches.
- 3.3 Items of the work given are broad indications for progressive payment. Notwithstanding the descriptions, BOQ and drawings issued with the tender, offer for which system must be complete in all respects in ready to use condition. Contractor must include all items necessary and required, whether described in the specification, drawings.

4 Pumping Sets for Water Transfer Pumps

- 4.1 Water supply pumps shall be suitable for clean filtered water. Pumps shall be single/multi stage vertical, centrifugal pumps with stainless steel 304 body and stainless steel (DIN W-Nr .1.4301) 304 impeller, stainless steel 316 shaft and mechanical seal and coupled to a TEFC electric motor. Each pump should be operating to a curve required by the operating conditions.
- 4.2 All parts in contract with water shall be corrosion resistant stainless steel DIN-Nr.1.4401.
- 4.3 Each pump shall be provided with a totally enclosed fan cooled induction motor of suitable H.P. The motors shall be suitable for 410 volts, 3 phases, 50 cycles A.C. power supply and shall conform to IS 325 operating at 2900 RPM nominal speed.
- 4.4 Each pumping set shall be provided with 100-mm dia gunmetal "Borden" type pressure gauge with gunmetal valve and connecting piping.
- 4.5 Pump or the whole set shall be stable on rubber vibration eliminating pads appropriate for each pump as recommended by the manufacturer and accepted by the Engineer-in-Charge/Owner rep.

5. Submersible Pumps

- 5.1 Submersible pumps for sewage/drainage shall be single stage, single entry pump. Pump shall be with C.I. casing and C.I. two vane enclosed type dynamically balanced impeller connected to a common SS-304 shaft to the motor. The vane for sewage pump will be open type, while for drainage pump etc. It will be of semi open type.
- 5.2 Stuffing box shall be provided with mechanical seals
- 5.3 Each pump shall be provided with water cooled squirrel cage induction motor suitable for 415 volts, 3 phase, 50 cycles AC power supply.
- 5.4 Each pump shall be provided with liquid level controller for operating the pump between predetermined levels. Operation of level controller shall be similar to as discussed in Para 6.1 & 6.2 below.
- 5.5 The pumping set shall be for stationary application and shall be provided with pump connector in it. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation, without disturbing delivery pipe the pump unit shall have a back pull out design. A rust proof chain shall be provided for each pump.
- 5.6 Pump shall be provided with all accessories and devices necessary and required for the pump to make a complete working system.

6. Level Controllers

- 6.1 Level controllers shall be electronic low voltage type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe. The level controller will be used for following applications: -
- 6.2 Filter feed pump and domestic water transfer pump.

To start/cut off all operating pumps when:-

- a) Water level is low in storage water tanks with low water level audible alarm.
- b) To cut off filter feed pump and domestic water transfer pump when water in tank is full.

6.3 Sump Pump level controller & high water alarm

To cut off the drainage sump pump when the sump is empty and to start when:-

- a) Duty pump No. 1 at pre-determined level No.1
- b) Duty pump No. 2 at a higher pre-determined level.No.2

7. Pipe & Fittings (for Headers and Connections)

7.1 Pump suction and delivery headers shall be Galvanized iron pipes (heavy class) with matching fittings. The pipe joints shall be threaded as per manufacturer's instructions.

7.2 Vibration Eliminators

Provide on all suction and delivery lines as shown on the drawings double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

7.3 Valves

7.3.1 Butterfly Valves

Butterfly Valves shall be cast iron body with following details:-

- a) Disc shall be CI heavy duty electrolysis nickel plated abrasion resistant.
- b) The shaft is EN-8 Carbon Steel with low friction nylon bearings.
- c) The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.
- d) Built in flanged rubber seals.
- e) Actuator to level operated for valves above ground and T Key operated for valves below ground.
- f) Built in flanges for screwed on flanged connections.

Manufacturer's details on fixing and installation will be followed.

7.3.2 Non Return Valves (NRV)

- a) Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.
- b) NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges. Valves shall conform BS.

8. Painting and cleanup

- a) On completion of the installation contractor shall scrub clean all pumps, piping, filters and equipment and apply one coat of primer.
- b) Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes.
- c) Provide painted identification legend and direction arrows on all equipment and piping as directed by engineer-in-charge.
- d) On final completion of the work, contractor should cleanup the site, filter room of all surplus materials rubbish and leave the place in a broom-clean condition.

Water Treatment Equipment's

3. Water Filters for Water Supply

- 3.1 Filter shall be designed in accordance with the code of unfired pressure vessel conforming to I.S. 2825.
- 3.2 Water filter shall be pressure dual media filter. Filter shall be externally painted with 2 coat of synthetic enamel paint over a coat of zinc chromate primer. Internal surface of filter shall be painted with epoxy primer and paint.
- 3.3 Filters shall be vertical type of required diameter. The shell and dished ends shall be fabricated from M.S. sheet tank suitable to with stand a working pressure given in Scope of work/ GFC drawings. The shell shall have a minimum thickness of 6 mm and dished ends 8 mm or as per manufactures recommendations.
- 3.4 Each filter shall have at least one pressure tight manhole cover for inspection and repairs.
- 3.5 Each filter shall be provided with screwed or flanged connections for inlet, outlet individual drain connections and all face piping, diaphragm valves and all other connections necessary and required.
- 3.6 Face piping shall be UPVC ASTM Schedule-80 pipe.

4. Water Softener

- 4.1 Softeners shall be designed in accordance with the code of unfired pressure vessel conforming to I.S. 2825.
- 4.2 Softeners shall be designed to remove the hardness of water. Softener shall provide with suitable grade of Cation exchange resins in quantity to be indicated by the contractor at the time of tendering.
- 4.3 Softener vessel shall be fabricated from MS sheet with dished ends and self-supporting arrangement. Vessel shall be suitable for a working pressure given in bill of quantities. The shell shall have a minimum thickness of 6 mm and dished ends 8 mm. Softener shall be externally painted with 2 coat of synthetic enamel paint over a coat of zinc chromate primer. Internal surface of Softener shall be painted with epoxy primer and paint.
- 4.4 The vessel shall have an internal collecting and distribution system of manufacturer's design.
- 4.5 Softener shall have a set of face piping for inlet, outlet brine injection with all valves. Suitable drain shall be provided. Pipes shall be UPVC ASTM Schedule-80 pipe.
- 4.6 One set of hydraulic injector with control valve, brine delivery pipes with adjustable indicating lamps.
- 4.7 One cylindrical FRP saturator and mixing tank, provided with brine delivery piping with adjustable level indicating clamp and control valves complete. The tank shall be of capacity as given in the bill of quantities.
- 4.8 One orifice board for indicating wash and rinse rate to be filtered in drain sump.
- 4.9 One charge of supporting gravel, sand and "Cation" resin in requisite quantity.

4.10 One water testing kit with instructions for testing water samples.

5. Chemical Dosing Pump

5.1 Chemical dosing system comprising of metering pump, 100 lts. Capacity HDPE solution tank with level gauge and lid on top.

5.2 Motor driven metering pump with mechanically activated diaphragm with oil lubricated gear mechanism. The output of the plug should be adjustable operation from 10-100 %. Pump construction shall be corrosion resistant polypropylene or similar material.

5.3 Each pump shall be provided with an injector assembly with suction and delivery piping complete in all respects.

6.0 R.O. PLANT

The water treatment equipment shall be based on the following Criteria:

6.1 Water Parameters

S.No.	Parameters	Unit	Desirable Limits Drinking Water as per IS 10500	Extended Limits Drinking Water as per IS 10500
1	Colour	hazen	5	
2	Odour	-	-	
3	Taste	-	-	
4	Turbidity	NTU	5	
5	PH Valve	-	6.5 - 8.5	
6	Total Hardness (as CaCo3)	mg/l	300	600
7	Iron (as Fe)	mg/l	0.3	
8	Chlorides (as Cl)	mg/l	250	1000
9	Fluoride (as F)	mg/l	1	
10	Total Dissolved Solids	mg/l	500	2000
11	Calcium (as Ca)	mg/l	75	
12	Magnesium (as Mg)	mg/l	30	100
13	Copper (as Cu)	mg/l	0.05	
14	Manganese (as Mn)	mg/l	0.1	
15	Sulphate (as SO4)	mg/l	200	400
16	Nitrate (as NO3)	mg/l	45	
17	Pheriolic Compounds	mg/l	0.001	

18	Mercury (as Hg)	mg/l	0.001	
19	Cadmium (as Cd)	mg/l	0.01	
20	Selenium (as Se)	mg/l	0.01	
21	Arsenic (as As)	mg/l	0.01	
22	Cyanide (as CN)	mg/l	0.05	
23	Lead (as Pb)	mg/l	0.05	
24	Zinc (as Zn)	mg/l	5	
25	Detergents	mg/l	0.2	
26	Chromium Total (as Cr)	mg/l	0.05	
27	Total Alkalinity	mg/l	200	
28	Aluminium (as Al)	mg/l	0.03	
29	Boron (as B)	mg/l	1	

6.2 Required Treated Water Parameters

S. No.	Parameter	Unit	Value
1	PH Value	-	7.2 – 7.5
2	Colour	hazen	Clear
3	Total Hardness	mg/l	< 50
4	Iron	mg/l	< 0.05
5	Chlorides	mg/l	< 50
6	Total Dissolved Solids	mg/l	< 100
7	Magnesium	mg/l	Nil
8	Sulphate	mg/l	< 100

6.3 Reverse Osmosis Plant

6.3.1 Reverse Osmosis plant shall consist of:

- a) Sodium Hypo-chloride dosing system to reduce the organic matter present in the raw water
- b) Chemical dosing system to neutralize residual free chlorine present in the filter water for complete de-chlorination.
- c) Antiscalant dosing system to protect the membranes from fouling.
- d) 5-micron cartridge filter is to be provided as per treatment to the R.O. system to protect R.O. membranes from chocking.
- e) R.O. high pressure feed pump shall be vertical multistage stainless steel centrifugal pump connected to direct driven totally enclosed fan cooled cage induction motor of required H.P. The motor shall be suitable for 410 volts, 3 phase, 50 cycles, A.C power and shall confirm to IS: 325 operating at 2900 RPM nominal speed.

- f) Reverse osmosis membranes of required quantity as per manufacturer's. The elements shall be hollow fiber or spiral wound having a high filtration rates. Elements must have a high operational life and sturdy.
- g) The entire plant must be provided with all controls, sensing devices, conductivity meter, pressure gauges, valve and all other accessories necessary and required for a complete operational plant.
- h) The entire plant shall be of approved corrosion resistant materials to be clearly specified in the bid.

6.4 Process of R.O. Treatment Plant

- a) The Water is passed through cartridges filter.
- b) High Pressure booster pump shall be provided to boost the pressure of water from cartridge Filter. The water at designed pressure shall be entering into RO Module.
- c) The Treated water from R.O. Module to be stored in treated water storage tank after dosed with pH enhancing chemicals (sodium carbonate) through pH dosing system to raise the pH To 7.4.
- d) The rejected water from the R.O. Plant shall be sends to the normal drain and finally connected With deep rainwater harvesting pit (up to sea water level).
- e) A chemical holding tank and necessary piping shall be installed to conduct onsite cleaning of Membranes.

7. Pipe & Fittings (for Headers and Connections)

- 7.1 Pump suction and delivery headers shall be of approved corrosion resistant material with matching fittings. The pipe joints shall be threaded or as per manufacturer's instructions.

7.2 Vibration Eliminators

Provide on all suction and delivery lines as shown on the drawings double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

7.3 Valves

Valves 50 mm dia and above shall be rubber lined butterfly valves.

Non return valves shall be rubber lines cast iron slim type of approved make.

8. Flow measurement

- 8.1 Provide Rota meter reading "LPH" or "LPM" on delivery line of the plant.
- 8.2. Provide one direct reading flanged type water meter with strainer on outlet of water softener or water filter.

9. Painting and cleanup

- a) On completion of the installation contractor shall scrub clean all pumps, piping, filters and equipment and apply one coat of primer.
- b) Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes.
- c) Provide painted identification legend and direction arrows on all equipment and piping as directed by Engineer-in-Charge.
- d) On final completion of the work, contractor shall cleanup the site, filter room of all surplus materials rubbish and leave the place in a broom-clean condition.

Sewage Treatment Plant

1 Basis of Design

The capacity/ rating of pumps and equipment etc. shall hold good for the capacity of STP as mentioned in Design report / Drawings and shall be good for meeting the treated parameters requirement as follows:

- a. Permissible limit as prescribed in IS:2490 (Part-I) – 1974 and environment (Protection) Rules 1986.
- b. Water (Prevention and Control of Pollution) Act, 1977 & 1978.
- c. Environment (Protection) Act, 1986.
- d. Environment (Protection) Rules, 1986.
- e. Hazardous Wastes (Management & Handling) Rules, 1989.
- f. Manufacturer, Storage and Import of Hazardous Chemicals Rules, 1989.
- g. Manufacturer, use import and storage and hazardous Micro-Organizers, Genetically Engineer-in-charge organizations or Cell Rules, 1989.
- h. Manual on sewage & sewage treatment - CPHEEO
- i. The Public Liability Insurance Act, 1991.
- j. All standards as laid down by Central Pollution Control Board and any other relevant statutory authority.
- k. 100% recycle of waste water and removal of sludge in cake form, no water to be discharged outside to the premises.

2. General

The sewage treatment plant (STP) system outlined in this section specifies the system design, manufacture, supply and installation Testing & Commissioning of submerged hollow fiber based MBR (Membrane Bio Reactor) system acceptable to Water and Sanitation Authority Requirement, Local Pollution Control Board Norms, World Health Organization Guidelines, the local Environmental and Pollution Control Authorities and subject to the approval of the Engineer-in-charge.

The work shall be carried out in a manner consistent with good practice in the local market. The Contractor shall take into account all site conditions in designing the system and selecting the equipment.

The Contractor shall be responsible for engaging a STP specialist to perform the system design and obtain approval from relevant Authorities. A qualified and experienced Engineer-in-charge shall be engaged for the system design, preparation of system proposal submission, obtaining approval and site supervision.

The Contractor shall perform the system design based on the criteria/data and component technical requirements specified in this section/drawings and the local Authorities' regulation/requirement.

The Contractor shall furnish system which comprises products of manufacturers who have designed and made these associated products for a period of at least five years.

The Contractor shall submit complete catalogue information, design calculation and samples complete with full technical data and shop drawings for the entire system, test certificates, etc. for acceptance prior to commencement of installation.

The Contractor shall submit analytical test reports of effluent water samples after the commissioning or after the system is put into operation or as required by the Engineer-in-charge:

(a) First 3 months – 15 days

The report shall contain analysis of all data related to those requirements laid down by the local Authorities.

As a minimum the following items shall be measured and analyzed as indicated under clause 2.1 following.

3. Design Criteria

It shall be the Contractor's responsibility to ensure the quality of the treated effluent to comply with the local Authorities requirement and the following characteristics, whichever is stringent.

	<u>Item of Analysis</u>	<u>Units in Milligram per litre or otherwise stated</u>
1	Colour	7 Lovibond units
2	pH value	6 - 8.0
3	BOD (5 day at 20°C)	5
4	COD	20
5	Total Suspended Solids	50
6	Grease and Oil	10
7	Phosphate (PO ₄)	1
8	E-coli	Nil
9.	Turbidity (NTU / JTU)	< 1

The effluent from the Sewage Treatment Plant shall be suitably treated and the effluent water recovered shall be used for Flushing, irrigation and Cooling Tower make-up.

4. Description of Process

The treatment process shall comprise the following stages:

For MBR System

- Physical treatment: Coarse & Fine bar-screening
- Primary treatment: Oil & Grease Trap & Grit Chamber
- Equalization tank: Flow equalization with air mixing
- Biological treatment: Aeration With MBR
- Disinfection UV unit with chlorination system as standby

- Digester: Aerobic digestion with diffused air system
- Water reclamation: Tertiary Softening
(for C.T cooling purpose)
- Sludge disposal: Sludge chemical conditioning
and dewatering

The biodegradable detergent will be discharged into the Sewage Treatment Plant. The Contractor shall provide the special equipment, etc. and defoaming agent for the treatment of the detergent such as providing the froth pump to remove the foam and FeCl_3 for phosphate removal.

5. Performance Criteria of the Plant

Raw sewage will be brought into the Sewage Treatment Plant. The Contractor shall receive sewage from this point to the treatment plant for treatment process.

The treatment plant shall be designed to treat the following basic characteristic expected in the raw sewage.

- i. Capacity (Max). : STP as mentioned in Design Report / Drawings
- ii. Operation : Domestic Sewage (round the clock)
- iii. Incoming Influent
 - a. pH - 6.0 to 8.5
 - b. BOD 5 days @ 20 deg. C. - 500 mg/l
 - c. Suspended solids (SS) - 250 to 400 mg/l
 - d. Oil & grease - 50 to 100 mg/l
 - e. COD 5 - 600 to 750 mg/l
- iv. Final Effluent after filtration)
 - a. pH - 6.5-8.5
 - b. BOD 5 days @ 20 deg. C. - Less than 5 Mg/L
 - c. Suspended solids (SS) - Less than 5 Mg/L
 - d. COD - Less than 10 Mg/L
 - e. Oil & grease (after grease trap) - Nil

Treated effluent shall be connected to a tertiary filtration / treatment and shall be treated for use for flushing, irrigation and cooling tower make-up purpose. The Contractor shall carefully consider the operation loading for the Sewage Treatment Plant.

6. Process Description

For MBR System

The out fall sewer main from the last manholes, will be let into a screening chamber by gravity flow. Large solids particles shall be intercepted by a bar screen, preceded by a grease trap. The primary clarified wastewater is then further pre-treated by fine screening before entering the bioreactor portion of the MBR process. Fine screening shall be done by proposed bar screen.

- a. The sewage after screening is collected in an oil & grease trap after that goes-in to grit chamber & finally to the equalization tank for smoothing out peak flows. This tank is sized to accommodate peaks, as well as breakdown buffer. The provision of air shall be kept in this tank to break the solids in suspension and to homogenize the sewage.
- b. The homogenized effluent is then pumped into the Biological reactor for the removal of BOD, COD, Phosphate and Nitrates. The reactor is equipped to perform suspension growth of microorganism (Mixed Liquor) in 12000-15000 MLSS. The air shall be provided through an air diffusion system all-round the membrane to soccer the sludge & for biological treatment of sewage in the reactor.
- c. The mixed liquor suspended solids from the bioreactor is then transferred to the submerged hollow fiber based membrane tank consists of S.S housing, air diffusion system, permeate water manifold & membrane elements. U.F. membrane (0.1 micron pore size) system shall be work to separate the sludge

and the treated effluent. The treated water passed through U.V unit for disinfection purpose and stored in a Clear water tank for further reuse.

- d. Depending on the MLSS to be retained in the Biological reactor the sludge is wasted. The wasted sludge is collected in sludge thicker and aerated with diffused aeration and then sludge shall be feed to filter press where sludge shall be collected in the form of Cake for manure use & primate shall be send back to equalization tank.
- e. To avoid the membrane to get chocked due to bacteria generation in membrane & organic substance, chemical cleaning (CIP) shall be carried out on regular intervals as required for removing substances polluting and clogging the membranes. Normal cleaners used are sodium hypo chloride and citric acid.

7. Equipment

The following give the minimum requirements of the different components of the system. The figures indicated are for contractor's references. It shall be the Contractor's responsibility to select equipment for the plant proposed by them so that the capacities and performance of the Sewage Treatment Plant meet with the criteria set out in this specification.

All equipment and components of the system shall be of top quality construction and shall be corrosion resistant.

8. Inlet Screen Chamber

Raw sewage shall flow into the inlet screen chamber by gravity. Large solids particles shall be intercepted by a Coarse & fine step screen. A manual screen shall be installed in parallel with the screw screen as a standby screen when the step screen is under maintenance.

9. Equalization Tank

The equalization tank shall be designed to provide a minimum storage of 3 hours at peak flow while pumping. Two submersible pumps as per schedule shall be provided with level switch control and automatic cut-in of the standby unit.

An aeration system similar to the extended aeration tank shall be provided for mixing and aerating the sewage.

10. Air Blowers

Air blowers shall be provided in duplicate (i.e. one duty and one standby). Blowers shall be either of positive displacement or centrifugal with pressure vessel type complete with motor, base-plate, inlet filter, intake silencer and off-load starting system outlet silencer, anti-vibration damper, flexible coupling, filter restriction indicator, non-return valve, pressure relief valve, V-belt system or direct drive coupling. The casing rotor shall be of cast iron construction. Bearings and gears shall be grease lubricated. Motor speed shall be not less than 1500 rpm.

The size and performance of the air blower shall be so selected that it can provide a minimum air flow rate 0.4 l /sec / diffuser to 1l/sec/diffuser maximum, and to maintain a minimum of 2.0mg/liters dissolved oxygen in the aeration tanks in operation.

11. MBR Tank

Sewage shall be retained in MBR tank subjected to biochemical oxidation by fine bubbles aeration.

12. Air Diffusers for Equalization, Sludge holding tank

Air diffusers shall be made to provide a uniform distribution of fine bubble air release performance in the system. The air diffuser shall be either made of elastomer rubber membrane or composed of crystalline fused aluminium oxide with a suitable ceramic bonding material.

Membrane endurance shall be more than 180,000 expansion/contraction cycles.

Diffuser shall be of self-cleaning, non-clog disc or dome-shaped type. Oxygen transfer efficiency shall not be less than 20% at 3.5m submergence in clear water. Alternatives may be offered for consideration.

Diffuser hold down assemblies shall consist of a retainer bolt, a matching washer and gasket. Sealing gasket shall be composed of solid neoprene rubber and shall be conform to ASTM D-2000 and shall be suitable for withstanding the effects of wastewater high temperature up to 120°C.

The Contractor shall submit calculation to justify the diffuser selection and air requirement during the detailed design.

13. Membrane Module: -

Membrane module shall comprise of housing of membranes, aeration diffusers, prime water manifold membrane element.

Membrane should be combined in to bundles wound a carrier cartridge which can allow for high pressure air scurrying for cleaning.

Membrane should have maximum 0.04 Micron size but pore hole may be as per manufacturer specifications

14. Disinfection Tank

Waster shall be passed through UV unit for disinfection, as standby measure chlorine solution shall be metered in to the effluent by an electric dosing pump paced according to the sewage inflow. The effluent shall be retained in the baffle walled chlorine tank for a minimum of 30 minutes for effective disinfection prior to discharge.

15. Sewage feed, sludge transfer & permeate suction Pumps

Working and standby sewage pumps shall be provided.

Each shall be of non-submersible type centrifugal pump with suction grid and automatic discharge connection. Pump casing and impeller shall be of cast iron material. Shaft shall be of CS material.

16. Sludge Transfer and Disposal Pumps

Two numbers of sludge feed pumps to filter press (one duty and one standby) shall be provided.

Each shall be of screw type pumps. The material construction shall be the same as the sewage pumps.

17. Chlorination System (Standby System)

A chlorine contact tank with a capacity of not less than 30 min average flow detention shall be furnished. It shall be attached to the settling tank. Construction shall be similar to the other tanks and panels comprising the treatment plant, and shall

include flow diversion baffles and outlet of the chlorine contact chamber for measuring the waste flow.

A chlorine feed system shall be furnished as a complete package assembly for installation in the plant room. Assembly shall include base plate, electronic positive displacement type chemical feed pump, fiber glass solution tank, suction and discharge tubing and fittings.

Each chlorine solution dosing pump shall perform to achieve a residue not more than 1 mg/l in the treated effluent. Solution feed pump shall have a maximum capacity of 1 l/hr. chemical pump will operate on 50 Hz supply. Fiberglass solution tank shall be of no less than 200 litre capacity and include suction line fitted with strainer.

Control shall be by means of compound loop (i.e. flow proportional and residual measuring).

The feed pump shall be of variable speed positive displacement, solenoid-riven diaphragm metering type. The construction material shall be suitable for corrosive nature and as follows:

18. Treated Water Transfer Pumps /Softener Feed Pumps /Soft Water Transfer Pumps

Working and standby Treated/ Soft Water Transfer pumps shall be provided.

19. UV Unit / System

UV system for disinfection shall utilize high purity quartz sleeves and high output UV lamps. UV Reactor MOC will be SS316L. System shall be designed to provide a UV dose of 600 J/m² at UVT of 65% and TSS less than 10 mg/L. System should deliver a 4 log reduction of coliforms and provide TC count to less than 200 CFU/100ml. The electrical control system should utilize high frequency electronic ballasts and provide efficiency of more than 90%. The reactor vessel shall utilize internal baffles to ensure turbulent and plug flow.

The UV intensity monitoring system shall be designed in accordance with the German DUGW W294 standard. The sensor shall be of dry type and removable without system shutdown.

The tertiary treatment plant shall comprise of the pressure sand filters and activated carbon filters. This shall be sized to accommodate 100% of the effluent discharge flow rate and shall achieve the performance as outlined and described in Design Criteria.

Details of the equipment layout proposal shall be submitted for review by the Engineer-in-charge with tender documents.

20. Electrical Control

The operation of the treatment process shall be fully automatic.

A completely assembled and prewired control panel with mimic diagram consisting of weatherproof cabinet shall be furnished. The control panel shall contain all metering and status indicators, motor starters, program timers, on-off-auto change-over switches and duty selectors for equipment.

Proper control sequence shall be designed according to system requirement and manufacturer standards,

21. Other Equipment

Any other necessary accessories, such as buffer, riser, partition, control panel, collection devices, etc. for all the tanks and pumps (where necessary) shall be provided in order to provide a fully working systems.

22. Piping Materials

SS304	-	Submerged air piping
MS epoxy	-	Air piping and pumped effluent riser (Non submerged)
PVC piping	-	Pumped effluent (submerged) & tank overflow pipe line.
GI (Heavy)	-	Interconnecting pipe line after delivery header of pump / filter.

23. Valves

The Contractor shall supply and install all isolating valves and control valves as indicated on the drawings and as required for the proper and efficient operation and maintenance of the entire systems.

All valves supplied shall be suitable for the working pressure and test pressure of the system as specified elsewhere in this specification.

Regulating valves shall be of similar materials as that specified for cast iron gate valves.

All regulating valves shall be lock shield type.

All valves shall be full line size.

Each valve shall have a purpose made reference number plate for label engraved or stamped indicating the manufacturer's catalogue number, pressure and temperature ratings. Valves shall be arranged so that clockwise rotation of the spindle will close the valve. Dymo labels are not acceptable.

Furnish all valves and accessory materials necessary in the piping whether or not shown on drawings as flows.

All valves shall be packed with an approved packing and threads shall be coated with oil and graphite. Packings should be replaced when found deteriorated on site.

Where possible locate all valves at convenient positions of operation from the floor with valve stems upright.

Valves that are flanged shall have flanges to the table specified for the pipe work.

Plastic or metal plates (rustless) shall be provided to indicate the open / close status as well as the use of each valve in the pump and tank rooms.

Intrudence clause of pipe support here.

24. Pipe Supports

General Support

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the

cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on or suspended from, on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. Risers shall be supported at each floor with Galvanised steel clamps. To permit free movement of common piping support shall be from a common hanger bar fabricated from Galvanised steel sections.

Piping shall be supported from the building structure, which shall support the sum of the load of a water-filled pipe and a minimum of 120 kg applied at the point of hanging.

All piping brackets shall be constructed as shown on the standard detail drawings.

Vertical pipe work shall be supported at intervals of at least one per floor level.

Horizontal pipe work shall also be supported by adjustable flat iron or clevis type hangers hung by hot rolled steel rods of the following diameters and spacing subject to the Architect's approval:

<u>Nominal Pipe Size</u>	<u>Distance between Supports</u>	<u>Diameter of Rod</u>
25 mm	1.8 m	10
32 mm	2.4 m	10
40 mm	2.7 m	10
50 mm	2.7 m	10
65-80 mm	3.0 m	12
100 mm	3.0 m	16
150-200 mm	3.6 m	18

The end of the steel rods shall be threaded and not welded to threaded bolt.

Hangers shall be supported by means of approved fasteners. Wood plugs shall not be used. Unless allowed by the structural Engineer-in-charge, power fixings may be used for pipe work of diameter less than 50 mm. Expansion fasteners may be used for vertical pipe work under 100 mm diameter.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

Requirement of Cut-outs in the structural slab or wall for installing the various pipes shall be clearly identified in the detailed shop drawing to be prepared by the STP contractor.

Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fiberglass and finished with retainer rings.

The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size gate valves.

Discharge from the air valves shall be piped through a pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

Pressure gauges shall be provided as shown on the approved drawings. Care shall be taken to protect pressure gauges during pressure testing.

25. Installation

The Contractor shall check the associated civil work prior to the installation of any item of machinery and advise the Engineer-in-Charge, in writing, of any deviation of such work from the specified details.

The machinery shall be accurately installed to correct dimensions, alignments, levels, etc., all as indicated on the final drawings. The machinery shall be mounted on flat steel packing pieces of thickness suitable to take up variations in level of the concrete foundations. Suitable packing pieces shall be located adjacent to each holding down bolt and shall be properly bedded by grinding the concrete surface to a smooth, level finish. The machinery shall be aligned and levelled and the nuts of the holding down bolts tightened with a spanner of normal length. The base plates shall be packed with grout after the machinery has been run and checked by the Engineer-in-charge for stability and vibration.

Installation shall include the provision and fixing of all necessary holding down bolts, washers, nuts etc.

The length of all bolts shall be such that when fitted with a nut and tightened the threaded portion of the bolts shall protrude from the top face of the nut by a distance not exceeding half the bolt diameter. Exposed bolt heads and nuts shall be hexagonal. All equipment and materials of the same type shall be products of the same manufacturer. Locally made equipment will not be accepted unless otherwise specified. All similar items of plant and their component part shall be completely interchangeable. Spare parts shall be manufactured from materials similar to the originals and shall fit all similar items of plant. Where machining may be needed before fitting renewable parts, the machining fits with their tolerance shall be shown on the drawings accompanying the instruction manuals.

All motors and/or revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds and any load up to the maximum there shall be no significant vibration due to lack of balance. All parts which can be worn or damaged by dust shall be totally enclosed in dust-proof housings.

26. Maintenance Facilities

Permanent work platform and catwalk shall be designed by the Contractor and provided by the Contractor for access to elevated equipment. The catwalk and platform for access shall allow a minimum width of 750mm.

Catwalk to maintenance platform shall be provided with railings and guards designed for safe movement of personnel in a restricted space including provision for gaining access and to accommodate maintenance personnel.

Hand railing and guards shall be designed by the Contractor and provided by the Contractor for all concrete tanks to allow safe movement of personnel.

Permanent I-beams, lifting eyes, etc. shall be provided by the Contractor over major equipment which requires lifting for overhaul and maintenance.

Waterproof power sockets required for servicing shall be provided by the Contractor. The number and locations shall be proposed by the Contractor and approved by the Engineer-in-charge/ Engineer-in-charge. Power supply to these sockets shall be taken from control panel of the sewage treatment system.

The design of all permanent work platform, hand rails, etc. shall be submitted to the Engineer-in-charge/ Engineer-in-charge for approval. The loading and fixing method of lifting facilitate shall also be submitted to the Engineer-in-charge/ Engineer-in-charge for approval and checking within 4 weeks on award of Contract or receipt of letter of intent.

27. Testing

The performance of the system shall be demonstrated by taking hourly samples of the raw sewage and final effluent over a twelve hour period. The sample shall be taken at periods approximately the flow rates specified by the plant. The sample shall be combined and a 5-day BOD shall be run, the results of which must verify the capacity of the treatment plant prior to acceptance.

28. Training

Provided training facilities courses to ensure that the employer's staff associated with the project may acquire full knowledge and appreciation of all aspects of the design, day-to-day operation, breakdown and routine maintenance, and fault diagnosis of all plant, equipment and systems.

Training to the employer's staff shall be held as appropriate at the Contractor's or manufacturer's premises and on site. A detailed syllabus for each of the training courses specified or proposed and the timing of the courses shall be submitted for approval. The Contractor shall recommend the desirable qualifications and experience of the trainees to optimally benefit from the courses.

The Contractor shall be deemed to have include in his tender price the cost of providing training facilities as specified. In addition to the above, the Contractor shall submit to the Engineer-in-charge list describing such other spares and special tools, their number, price and where appropriate the anticipated frequency of replacement as soon as is practicable.

Hot Water System

1 Heat Pumps

The Packaged type Air to Water Heat Pump. shall be completely factory assembled including 2 Nos. Scroll Hermetically Sealed Scroll / Reciprocating Compressor(s), evaporator, Condenser and Microprocessor Control Panel etc. with 410 A Refrigerant and COP between 3-4. The Heat Pump shall have inbuilt hot water heat exchanger, vibration isolators, inbuilt cycle for defrosting in case icing occurs on evaporator, LCD display control panel with built in diagnostic and troubleshooting information, inbuilt tube in tube type heat exchanger, pumps, valves, expansion valve, Copper / Aluminium fins, and other accessories. The Heat Pump should be capable of producing hot water at minimum 55°C temperature at outlet (condenser circuit) temperatures at approx. 40°C ΔT. The Machine should have an operating ambient temperature range of 0°C to 40°C.

Heat Pump shall have built in electric panel as per safety norms & inbuilt BMS data integration as manufacturer standard. It shall be Suitable for electric supply of 220 + 10% volts & 50 Hz or 415 + 10% volts & 50 Hz. The Heat pump shall have an in-built facility to start / stop depending on variation in demand at different periods. All interconnecting wiring / cabling between heat pump and electrical panel shall be part of the equipment.

The Heat Pumps shall be installed in required nos. at terrace level of buildings.

2 Hot Water Storage Tank

Hot Water Storage Tanks shall have working pressure of 5.0 kg/sq.cm. The tank shall be made up of 5 mm thick sheet of SS-316L and insulated with 100 mm thick Glass/Rock wool insulation 80 kg/m³, covered with 24 SWG Aluminum sheet cladding to withstand a temperature of 100 deg centigrade. The tank is to be provided with manhole cover on top for cleaning and maintenance purpose.

Each hot water storage tank shall be provided with the following:

Coil type heat exchanger (wherever required)

Thermostatic control valve

Safety valve

One AIR Release valve

Pressure and temperature relief valve

High limit Temperature sensor

Primary flow connection

Hot water supply connection

Hot water return connection

Drain connection

Thermometer fitted (inserted) in thermo well

Pressure gauge

Make up tank

Ball valve

The hot water storage tank shall be hydrostatically tested to one and half times the working pressure of a system for a period of 24 hours without any leak. Field tests are to be performed at site to satisfy the capacity and operation of the unit by the Engineer- in-charge.

3.0 Plate Heat Exchanger

Heat Exchanger shall be SS-316 plate type heat exchanger.

Capacity of Heat Exchanger, Primary & Secondary Pumps as mentioned on GFC Drawings.

4.0 Recirculation Pump

Glandless circulation pump for pipe installation with manual 3-stage speed switch. With blocking-current proof motor. Pump housing made from cast iron (bronze depending on type), impeller made from glass reinforced plastic, stainless steel shaft with metal-impregnated carbon plain bearings. Used as standard in cold-water systems up to -10°C.

Operational safety thanks to drilled-through shaft and filter unit in front of the cartridge

5.0 Insulating Material

5.1 Insulation of R value = 3.34 m²co/W to with a temperature of 100 should be used. Typical insulation is:

S. No	Trade Name	K	R	X (Min)	M M
1	SPINTEX 300 OR EQV.	0.029	48	3.34	100
2.	TWIGA GLASS WOOL OR EQV>	0.033	48	3.34	100
3.	FIBERGLAS S crown white	0.228	48	3.34	100

The polythene sheet shall be used as covering between the glass wool and the cladding sheet besides the retaining material such as chicken mesh etc. Aluminum sheet of thickness 22 SWG shall be used for cladding the tank insulation.

The storage tank should be properly installed at site on M.S Channel stand properly grouted on roof with cement concrete pedestals of 1:1.5:3 ratios or any other specific provision as per site conditions as directed by Engineer-in-charge.

5.2 Inlet connection of cold-water supply line of required size (dedicated for solar) to be provided into the hot water tank.

6.0 Solar Panels

Solar Panels shall be flat plate type ISI Marked solar collectors' size 2 x 1 mtr approx.,

MS stands, supports, rubber EPDM gaskets with nut & bolts, rubber gasket for flanges, Clamps etc. shall be provided.

The system shall be capable to produce hot water 55 to 60 deg on clear sunny days and the efficiency of collectors should not be less than 72%.

7.0 Support Structure/Stand

- 7.1 The stand for the hot water storage tank are to be designed taking into consideration the load to be carried by the stand. The collector becomes vulnerable to wind dust. The collector may be up-listed by wind striking the underside. This wind load should be determined according to accepted engineering practices and procedures and the stands are to be designed taking into consideration the worst condition of loading.
- 7.2 The stand shall be fabricated from Heavy duty MS angles to support/mounting of solar water heater system accessories. The bottom of tube is to be supported with M.S support.
- 7.3 Necessary PCC Footings shall be provided as per requirements.

8.0 Valves:

- 8.1 Valves upto 50 mm dia shall be forged brass ball valves with brass body and chrome plated balls and operating handle.
- 8.2 Valves 65 mm dia and above shall be CI butterfly valves with CI handle as per IS : 13095.
- 8.3. Air Valve

An automatic air release valve on top of each hot water line to expel entrapped air shall be provided.

9.0 Water Meter

- 9.1 A water meter on the main cold water inlet on the terrace shall be provided .The water meter shall be provided with a brass strainer recommended by the meter manufacturer.
- 9.2 Main hot water outlet shall have a thermostatic mixing valve for controlling temperature.

10.0 Piping and Insulation Work

- 101 All pipes and fittings shall be SS-304.
- 10.2 Hot Water Pipes shall be insulated with 50 mm glass wool/rock wool insulation covered with chicken mesh & 24 SWG aluminum cladding or as specified in the scope of work.
- 10.3 All fittings shall be provided with screwed joints upto 50mm dia and flanged joint above 65mm dia, with flanges screwed complete and jointed with 3.0mm thick gasket complete with nuts, bolts and washers etc.

11.0 Instruction Manual

The manufacture should provide with each Solar heating system an instruction manual containing the following information: -

- a) Installation instructions, handling recommendations and safety precaution.
- b) Maintenance instruction for example cleaning of tubes, painting etc.
- c) As Built Drawings of the System Installation.

Fire Hydrant System

1.3 Pipes

- a. All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be MS pipes as follows:
- b. Pipes 150 mm dia and below IS: 1239 Heavy Class
- c. Pipe 200 mm dia and above IS 3589 of 6.35 mm thick.

External Fire Piping

All pipes used for External Fire Works (underground) shall be Ductile Iron Pipes (K-9) conforming to IS : 8329, including DI fittings class K-12 conforming to IS : 9523 suitable for push-on-joints or mechanical jointing ,

Ductile Iron Pipes shall be suitable for push-on-joints. Wherever required mechanical jointing also provided.

1.4 Pipe Fittings

- a) Pipes and fittings mean tees, elbows, couplings, flanges, reducers etc. and all Such connecting devices that are need to complete the piping work in its totality.
- b) Screwed fittings shall be approved type forged steel fittings suitable for screwed joints.
- c) Mild Steel butt weld fittings of approved type with "V" groove for welded joints.
- d) Fabricated fittings shall be not being permitted for pipe diameters 50 mm and below.

1.5 Jointing

1.5.1 Screwed (50 mm dia pipes and below)

Joint for MS pipes and fittings shall be metal to metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked.

1.5.2 Welded (65 mm dia and above)

Joints between M.S. pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Butt welded joints are not acceptable.

1.5.3 Flanges.

Flanged joints shall be provided on:

- a) Straight runs not exceeding 30 m on pipelines 80 mm dia and above.
- b) Both ends of any fabricated fittings e.g. bend tees etc. of 65 mm dia or larger diameter.
- c) Flanges shall be as per I.S: 6392-1971 Table 17/18 with appropriate number of half thread nuts bolts and make GKW, 3 mm insertion neoprene gasket complete.

1.5.4 Unions

Provide approved type of dismantable unions on pipes lines 65 mm and below in similar places as specified for flanges.

1.6 Excavation

Excavation for pipe lines shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipe lines shall be buried to a minimum depth of 1.2 meter or as shown on drawings.

Wherever required contractor shall support all trenches or adjoining structures with adequate timber supports.

On completion of testing and pipe protection, trenches shall be refilled with excavated earth in 15 cms layers and consolidated.

Contractor shall dispose of all surplus earth with in a lead of 200m or as directed by Engineer-in-Charge.

1.7 Anchor Thrust Blocks

- a) Contractor shall provide suitably designed anchor blocks in cement concrete to encounter excess thrust due to water hammer & high pressure.
- b) Thrust blocks shall be provided at all bends & tees & such other location as determined by the Engineer-in-Charge.
- c) Exact location, design, size and mix of the concrete block shall be approved by the Engineer-in-Charge prior to execution of work.

1.8 Valves

1.8.1 Ball Valves

- a) Valves 50 mm dia & below shall be heavy type nickel plated Brass body screwed type with chromium plated brass balls, PTFE Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/sq. cm including coupling and gunmetal handle conforming to B.S. 5351 with female screwed ends.
- b) All valves shall be approved by the Engineer-in-Charge before they are allowed to be used on work.

1.8.2 Butterfly Valves

Butterfly Valves shall be cast iron body and shall be of class P.N 16 tested to 20 kg/cm² with following details: -

- a) Disc shall be CI heavy duty electrolysis nickel plated abrasion resistant.
- b) The shaft is EN-8 Carbon Steel with low friction nylon bearings.
- c) The seat shall be drop tight constructed by bonding resilient electrometer inside a rigid backing.
- d) Built in flanged rubber seals.

- e) Actuator to level operated for valves above ground and T Key operated for valves below ground.
- f) Built in flanges for screwed on flanged connections.

Manufacturer's details on fixing and installation will be followed.

1.8.3 Non-Return Valves (NRV) cast iron dual plate type non return valves of PN 16.

- a) Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.
- b) Non-return valves shall be wafer type dual plate check valve with cast iron body and disk, S. Steel pin and hinges, nitrite/neoprene seal, suitable for horizontal/vertical line installation conforming to IS: 5312.

1.8.4 Air vessel / Air Cushion tank.

- a) Air cushion tank shall be of size and capacity indicated in schedule of quantities. It shall be provided at the top most point/points and/or in pump house (as specified). The tank shall be complete 25 mm dia. Brass Air Valve (Ball type), Stop Valve (25mm dia), Drain valve (25mm dia) and pressure gauge including 25mm dia. Mild Steel M.S. pipes and fittings, unions, etc. as required to complete the work as per site conditions.

1.8.5 Air Cushion tank shall be measured by numbers and shall include Air Valve, Pressure Gauge, and Globe Valves for testing and draining, M.S. Clamps, Pipes, Fittings, Tees Elbows Union and all other items required completing the work.

1.8.6 Orifice Flanges

Provide orifice flanges fabricated from 6 mm thick stainless steel plate to reduce pressure on individual hydrants to restrict the operating pressure to 3.5 kg/cm² and allow a discharge of 560 lpm.

1.8.7 Drain Valve

Provide 25 mm dia black steel pipe to IS: 1239 (heavy class) with 25 mm Ball valve for draining any water in the system in low pockets.

1.8.8 Inspection & testing assembly

Inspection and testing of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye-pass valve. The drain pipe beyond the valve upto the drainage point shall be measured with the pipe.

1.8.9. Pump test assembly

Provide on the main fire sprinkler header a 150 mm dia bye pass valve located in an accessible manner along with a rate of flow rotometer calibrated in lpm and able to read 200 % of the rated pump capacity. The delivery shall be connected to the fire tank.

1.8.10 Pressure Gauge

Pressure gauge shall be provided at pump room area and terrace hydrants only. Pressure gauge shall be 100 mm dia gunmetal Bourden type with gunmetal isolation cock, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate level and height for easy readability.

2.0 Hydrant/Valve chambers

- 2.1 Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 15 mm thick cement plaster inside and outside finished with a

Floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete.

- 2.2 Valve chambers shall be 120 x120 cms. For depths up to 100 cms.

3.0 Fire Brigade Connections

Provide as shown on drawings separate gunmetal 4 way collecting head with four 63 mm instantaneous type inlets with built in check valves and 150 mm dia outlet connected to the fire and sprinkler main. Collecting head shall be installed on a stand post and provided with horizontal C.I. reflux valve and location to be approved by Engineer-in-Charge. Provide etched gunmetal label plates with 50mm height letter. The plates should be firmly fixed to the FB connection and any support system.

4.0 Fire Hydrants

4.1 External Hydrants

- a) Contractor shall provide external hydrants. The hydrants shall be single headed Stainless Steel landing valve with instantaneous type 63 mm dia outlet, controlled by a cast iron butterfly valve installed in underground lockable chambers. The hydrants shall be conforming to I.S. 5290 with bend, M.S. flanged riser of required height to bring the hydrant to correct level above ground.
- b) Contractor shall provide for each external fire hydrant station two numbers of 63 mm dia. 15 m long non percolating rubberized fabric lined hose pipes to I.S. 636 Type A with Stainless Steel and female instantaneous type coupling to I.S. 903 riveted and bound with 1.5 mm copper wire to hose pipe, fire hose reel, Stainless Steel branch pipe with nozzle I.S. 903.

4.2 Internal Hydrants

- a) Contractor shall provide on each landing and other locations as shown on the drawings one single headed Stainless Steel landing valve with 63 mm dia outlet mounted on a common 80 mm inlet (I.S.5290-1969). Landing valve shall have flanged inlet and instantaneous type outlets as shown on the drawings.
- b) Instantaneous outlets for fire hydrants shall be of standard pattern approved and suitable for fire brigade hoses.
- c) Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long non percolating rubberized fabric lined hose pipes to I.S. 636 Type A with Stainless Steel male and female instantaneous type coupling to I.S. 903 riveted and bound with 1.5 mm copper wire to hose pipe, fire hose reel, gunmetal branch pipe with nozzle I.S. 903.
- d) Each hose box shall be conspicuously painted with the letters "FIRE HOSE".

4.3 Fire Hose Reels

Contractor shall provide standard fire hose reels with 20 mm dia high pressure (10 Kg/cm²) thermo plastic hose tube conforming to IS: 12585 Type II , 36.5 m long with Stainless Steel nozzle and control valve, shut off valve, all mounted on circular hose reel of heavy duty mild steel construction and cast iron brackets. Hose reel shall be

connected directly to the wet riser. Hose reel shall conform to IS: 884-1969 and rubber hose to IS: 5132.

4.4 Hose Cabinets

- a. Provide hose cabinets for all internal fire hydrants. Hose cabinets shall be fabricated from 16 gauge M.S. sheet of fully welded construction with hinged double front door partially glazed with locking arrangement, stove enameled fire red paint with "FIRE HOSE" written on it prominently

4.5 Pipe Supports

- a) All pipe clamps and supports shall be galvanized steel. When fabricated from M.S. steel sections, the supports shall be factory galvanized before use at site. Welding of galvanized clamps and supports will not be permitted.
- b) Pipes shall be hung by means of expandable anchor fastener of approved make and design (Dash Fasteners or equivalent). The hangers and clamps shall be fastened by means of galvanized nuts and bolts. The size/diameter of the anchor fastener and the clamp shall be suitable to carry the weight of water filled pipe and dead load normally accounted.

Pipe Spacing Table

		<----- Pipe commercial dia. ----->								
S.No.	Pipes & Position	15/20	20/25	32/40	50	75/80	100/110	150/160	200	
1	Vertical									
1.1	GI/MS	2.4	2.4	3	3.6	4.5	4.5	5.4	5.4	
1.2	CI Pipes IS 1729/3989	X	x	<----- 3 m ----->						
1.3	CI Heavy Duty IS 1536	X	x	<----- 3.6 m ----->						
1.4	uPVC SWR Systems	X	x	0.5	0.7	0.9	0.9	1.0		
1.5	uPVC Water Supply									
1.6	Polybutylene	<-----As per manufacturer's Recommendations								
1	Horizontal									
1.1	GI/MS	2.0	2.0	2.4	3.0	3.6	4.0	4.5	4.5	
1.2	CI Pipes IS 1729/3989			<-----3 m ----->						
1.3	CI Heavy Duty IS 1536					3.0	3.6	3.6	4.5	
1.4	uPVC SWR Systems				1.2	1.8	1.8	1.8		
1.5	uPVC Water Supply									
1.6	Polybutylene	<-As per manufacturer's recommendations----->								

4.6 Testing

- a. All piping in the system shall be tested to a hydrostatic pressure of 1.5 times the working pressure or 20 kg/sq.cm (whichever is more) without drop in pressure for at-least 2 hours.
- b. Rectify all leakages, adjust and retest as required and directed.

4.7 Cables

- a. Contractor shall provide control cables from supervisory valves and switches to the annunciation panels.
- b. All control cables shall be copper conductor PVC insulated armored and PVC sheathed 1100 volt grade.
- c. All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.
- d. All cable joints shall be made in an approved manner as per standard practice.

Cable Trays

- i All cables shall be routed in approved locations in coordination with all other services in a proper manner.
- ii Cable trays shall be of galvanized steel and hung from the ceiling by galvanized rods supported by appropriate size and type of expandable expansion fasteners drilled into the slabs and walls by an electric drill.

Specifications for Fire Sprinkler System

1.0 Scope of work

- 1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances including scaffolding, M.S. ladders etc. necessary and required to completely install wet riser fire hydrant and sprinkler system as required by the drawings and specified hereinafter or given in the Design Report
- 1.2 Without restricting to the generality of the foregoing, the work shall include but not limited to the following: -
 - a) Piping for Sprinkler systems.
 - b) Sprinkler heads, spare sprinklers
 - c) Inspection & test assemblies and accessories

2.0 General

- 2.1 All materials shall be new of the best quality conforming to the specifications and subject to the approval of the Engineer-in-Charge.
- 2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.4 Pipes shall be securely fixed to walls, and ceilings by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.
- 2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

3 Pipes

- a. All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be MS pipes as follows:
- b. Pipes 150 mm dia and below IS: 1239 Heavy Class
- c. Pipe 200 mm dia and above IS 3589 of 6.35 mm thick.

4 Pipe Fittings

- a) Pipes and fittings mean tees, elbows, couplings, flanges, reducers etc. and all Such connecting devices that are need to complete the piping work in its totality.
- b) Screwed fittings shall be approved type forged steel fittings suitable for screwed joints.
- c) Mild Steel butt weld fittings of approved type with "V" groove for welded joints.
- d) Fabricated fittings shall be not being permitted for pipe diameters 50 mm and below.

5 Jointing

5.1 Screwed (50 mm dia pipes and below)

Joint for MS pipes and fittings shall be metal to metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked.

5.2 Welded (65 mm dia and above)

Joints between M.S. pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Butt welded joints are not acceptable.

5.3 Flanged

Flanged joints shall be provided on:

- a) Straight runs not exceeding 30 m on pipe lines 80 mm dia and above.
- b) Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger Diameter.
- c) For jointing all types of valves, appurtenances, pumps, connections with other Type of pipes, to water tanks and other places necessary and required as Good for engineering practice.
- d) Flanges shall be as per I.S. with appropriate number of G.I. nuts and bolts, 3 mm Insertion neoprene gasket complete.

5.4 Unions

Provide approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges.

6 Excavation

6.1 Excavation for pipe lines shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipe lines shall be buried to a minimum depth of 1.2 meter or as shown on drawings.

6.2 Wherever required contractor shall support all trenches or adjoining structures with adequate timber supports.

6.3 On completion of testing and pipe protection, trenches shall be refilled with excavated earth in 15 cms layers and consolidated.

6.4 Contractor shall dispose of all surplus earth within a lead of 200 m or as directed by Engineer-in-Charge.

7 Anchor Thrust Blocks

a) Contractor shall provide suitably designed anchor blocks in cement concrete to encounter excess thrust due to water hammer & high pressure.

a) Thrust blocks shall be provided at all bends & tees & such other location as determined by the Engineer-in-Charge.

b) Exact location, design, size and mix of the concrete block shall be approved by the Engineer-in-Charge prior to execution of work.

8 Valves

8.1 Cast Iron Butterfly Valves

8.1.1 Valves 50 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

8.1.2 Butterfly valves shall be of best quality conforming to I.S.13095 of class specified.

8.3 Non-Return Valves (Check Valves)

Non-return valves shall be cast iron double flanged dual plate type with cast iron body and gunmetal internal parts conforming to IS: 5312.

8.4 Air Valves

Provide 25 mm dia screwed inlet cast iron single acting air valve, on all high points in the system or as shown on drawings.

8.5 Orifice Flanges

Provide orifice flanges fabricated from 6 mm thick stainless steel plate to reduce pressure on individual hydrants to restrict the operating pressure to 3.5 kg/cm² and allow a discharge of 560 lpm. The contractor shall submit design of the orifice flanges for approval before installation.

8.6 Drain Valve

Provide 50 mm dia black steel pipe to IS: 1239 (heavy class) with 50 mm gunmetal full way valve for draining any water in the system in low pockets.

8.7 Inspection & Testing Assembly

Inspection and testing of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, and bye-pass valve. The drain pipe beyond the valve upto the drainage point shall be measured with the pipe.

9. Pipe Protection

a) All pipes above ground and in exposed locations shall be painted with one coat of zinc chromate primer and two or more coats of synthetic enamel paint of approved shade.

b) Pipes in chase or buried underground shall be painted with two coats of zinc chromate primer and wrapped with one layer of 4 mm thick PYP COAT multilayer sheet as per standard manufacturer's specifications.

10. Pipe Supports

10.1 All pipe clamps and supports shall be galvanized steel. When fabricated from M.S. steel sections, the supports shall be factory galvanized before use at site. Welding of galvanized clamps and supports will not be permitted.

10.2 Pipes shall be hung by means of expandable anchor fastener of approved make and design (Dash Fasteners or equivalent). The hangers and clamps shall be fastened by means of galvanized nuts and bolts. The size/diameter of the anchor fastener and

the clamp shall be suitable to carry the weight of water filled pipe and dead load normally encounter.

11 Sprinkler Heads

11.1 Sprinkler heads shall be quartzoid bulb type with gunmetal body fully approved and having current certification of the fire laboratory of the C.B.R.I. Roorkee, Underwriter's laboratory (UL) and under the approved certified list of the Fire Office Committee (FOC) of U.K. or NFPA of USA. Any one of the certification as acceptable to the local fire authorities obtained prior to the procurement and approved and accepted by the Engineer-in-Charge.

11.2 Sprinkler heads shall be installed in conformity with approved shop drawings and in co-ordination with electrical fixtures, ventilation ducts, cable galleries and other services along the ceiling.

11.3 Following type of sprinklers shall be used:

S.No.	Type of Sprinkler	Temp rating °C
1.	Pendant or upright	68
2.	Special application quick wall Type with throw suitable for Room size of 5 m length (Extended type)	68
3.	Semi concealed type (Recessed in rosette)	68

11.4 Spacing and coverage of sprinkler shall be in accordance with risk classification of area in which they are installed, design density and TAC regulation.

12 Testing

12.1 All piping in the system shall be tested to a hydrostatic pressure of 14 kg/cm² without drop in pressure for at least 8 hours.

12.2 Rectify all leakages, make adjustments and retest as required and directed.

Fire Pumps & Ancillary Equipment

1 Scope of Work

- 1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel driven pumps as required by the drawings and specified hereinafter or given in the design Report.
- 1.2 Without restricting to the generality of the foregoing, the pumps and ancillary equipment shall include the following:-
- a) Electrically operated and diesel driven pumps with motors, base plates and accessories.
 - b) Alarm system with all accessories wiring and connections
 - c) Pressure gauges with isolation valves & piping bleed and block valves.
 - d) M.S. pipes, valves, suction strainers, delivery headers & accessories.
 - e) Foundations, vibration eliminator pads and foundation bolts.

2 General Requirements

- i) Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in the concrete foundations.
 - ii) Pumps and motors shall be truly aligned by suitable instruments.
 - iii) All pump connections shall be standard flanged type with appropriate number of bolts. In case of non-standard flanges companion flanges shall be provided with the pumps.
 - iv) Manufacturer's instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.
- a) Contractor shall provide necessary test certificates and performance charts with NPSH requirement of the pumps from the manufacturer. The Contractor shall provide facilities to the Engineer-in-Charge or their authorized representative for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the owners.
 - b) Each pump shall be provided with a 150 mm dia pressure gauge, isolation cock and connecting piping, bleed and block valve.
 - c) Provide vibration eliminating pad and connectors for each pump.
 - d) The Contractor shall submit with this tender a list of recommended spare parts for two years of normal operation and quote the prices for the same.

3 Fire, Sprinkler & Jockey Pumps

3.1 Pumping Sets

- a) Pumping sets shall be single stage single outlet with cast iron body and bronze dynamically balanced impellers. Connecting shaft shall be of stainless steel with bronze sleeve and grease lubricated bearings.

- b) Pumps shall be connected to the drive by means of spacer type love joy couplings which shall be individually balanced dynamically and statically.
- c) The coupling joining the prime movers with the pump shall be provided with a sheet metal guard.

3.2 Pumps shall be provided with approved type of mechanical seals.

3.3 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of the rated head.

3.4 The pump shall meet the requirements of the Tariff Advisory Committee and the unit shall be design proven in fire protection services.

4 Electric Drive

4.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps the motors should be rated not to draw starting current more than 3 times normal running current.

4.2 Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.

4.3 Motors shall be wound for class B insulation and winding shall be vacuum impregnated with heat and moisture resistant varnish glass fiber insulated.

4.4 Motors for fire pumps shall meet all requirements and specifications of the Tariff Advisory Committee.

4.5 Motors shall be suitable for $415 \pm 10\%$ volts, 3 phase 50 cycles a/c supply and shall be designed for 38 deg C ambient temperature. Motors shall conform to I.S. 325.

4.6 Motors shall be designed for two start system.

4.7 Motors shall be capable of handling the required starting torque of the pumps.

4.8 Contractor shall provide inbuilt heating arrangements for the motors for main pumps to ensure that motor windings shall remain dry.

4.9 Speed of the motor shall be compatible with the speed of the pump.

5 Diesel Engine

5.1 Diesel engine shall be of 6 cylinders with individual head assemblies. The engine shall be water cooled and shall include heat exchanger and connecting piping, strainer, isolating & pressure reducing valves, bye-pass line complete in all respects.

5.2 Engine shall be direct injection type with low noise and exhaust emission levels.

5.3 The speed of the engine shall match the pump speed for direct drive.

5.4 The engine shall be capable of being started without the use of wicks, cartridge heater, plugs or either at engine room temperature of 7 deg.C. and shall take full load within 15 seconds from the receipt of the signal to start.

5.5 The engine shall efficiently operate at 38 deg.C ambient temperature at 50 meters above mean sea level.

- 5.6 Noise level of the engine shall not exceed 105 DBA (free field sound pressure) at 3 meters distance.
- 5.7 The engine shall be self-starting type upto 4 deg C and shall be provided with one 24 volts heavy duty DC battery, starter, cut-out, battery leads complete in all respects. One additional spare battery shall be provided. The battery shall have a capacity of 180 to 200 ampere hours and 640 amps cold cranking amperage.
- 5.8 A battery re-charger of 10 to 15 amperes capacity with trickle and booster charging facility and regulator shall be provided.
- 5.9 The engine shall be provided with an oil bath or dry type air cleaner as per manufacturer's design.
- 5.10 Engine shall be suitable for running on high speed diesel oil.
- 5.11 The system shall be provided with a control panel with push button starting arrangement also and wired to the engine on a differential pressure gauge.
- 5.12 The entire system shall be mounted on a common structural base plate with ant vibration mountings and flexible connections on the suction and delivery piping.
- 5.13 One self supported one day oil tank fabricated from 5 mm thick MS sheet electrically welded with a capacity of 8 hours working load but not less than 200 lit shall be provided. Level indicating gauge glass on the day oil tank and low fuel level indication on the control panel shall also be provided.
- 5.14 One exhaust pipe with suitable muffler (residential type) to discharge the engine gases to outside open air as per site conditions shall be provided.
- 5.15 All other accessories fittings & fixtures necessary and required for a complete operating engine set shall be provided.
- 5.16 Contractor shall indicate special requirements, if any, for the ventilation of the pump room.
- 5.17 The materials of construction for the major components are as follows:
- Casting : Cast iron
 - Impeller : Bronze
 - Shaft : EN-8
 - Wear Rings : Bronze
 - Gland Packing : Graphite Asbestoc
 - Type of Bearing: Ball bearing/Roll Bearing
 - Type of coupling: Flexible couplings
- 5.18 Instrumentation
- The diesel engine shall be provided with the following instrumentation:
- a) Temperature indicator in cooling water inlet and outlet
 - b) Temperature indicator in lubricating oil outlet from the oil cooler
 - c) Pressure gauge for lubricating oil system
 - d) Speed indicator
 - e) Lubricating oil sump level indicator
 - f) Fuel oil tank level indicator
 - g) Voltmeter and ammeter in battery charging circuit
 - h) Cooling water high temperature alarm
 - i) Oil pressure low alarm

A local instrument panel shall be provided with the engine for mounting all the above instruments and annunciation.

- 5.19 Pumps and motor engine shall be mounted on a common base frames fabricated from M.S. structural and placed in suitable concrete foundations with the help of approved cushy foot mountings (Anti-vibration pads) to avoid vibrations. The anti-vibration pads shall be of heavy duty type.

6 Air Vessel

- 6.1 Provide one air vessel fabricated from 10 mm M.S. plate with dished ends 8 mm thick shell and suitable supporting legs. Air vessel shall be provided with a 50 mm dia connection from pump, one 25 mm dia drain with valve, one gunmetal water level gauge and 15 mm sockets for pressure switches. The vessel shall be 250 mm dia x 1000 mm high and tested to 20 kg/sq cm pressure.
- 6.2 The fire pumps shall operate on drop of pressure in the mains as given in Para 3.6.3 below. The pump operating sequence shall be arranged in a manner to start the pump automatically but should be stopped manually by starter push buttons only.

Notes:

- a) Jockey pump shall start and stop through pressure switch automatically.
- b) Jockey pump shall stop when main pump starts.

Main pumps shall start automatically on fall of pressure but stopping shall be manual.

7 Vibration Eliminators

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connector shall be as per manufactures details.

Fire Extinguishers

1 Scope of work

- 1.1 Work under this section shall consist of furnishing all labour, material, appliances and equipment necessary and required to install fire extinguishing hand appliances.
- 1.2 Without restricting to the generality of the foregoing the work shall consist of the following:-

Installation of fully charged and tested fire extinguishing hand appliances CO₂, foam, dry chemical powder type as required by these specifications and drawings.

2 General requirements

- 2.1 Fire extinguishers shall conform to the following Indian Standard Specifications and shall be with ISI approved stamp as revised and amended up to date:-

Note: All fire extinguishers should be Halon free gas as per Griha-4 standards.

- | | | |
|----|--------------------------------------|------------|
| a) | CO ₂ type | I.S. 15683 |
| b) | Dry powder type
(Stored pressure) | I.S. 15683 |

- 2.2 Fire extinguishers shall be installed as per Indian Standard "Code of Practice for Selection, Installation and Maintenance of Portable First Aid Appliances" I.S.2190-1962.
- 2.3 Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners.
- 2.4 Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.
- 2.5 All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

3 Modular Type Ceiling Mounted Fire Extinguishers

Modular ceiling mounted fire extinguisher, pressurized with clean agent type gas (HFC-236) and duly fitted with 68 deg C sprinkler complete in all respects including initial fill and ceiling suspension bracket etc.

Technical Data:

- Extinguishing Agent - HFC 236fa (UL approved Gas)
- Propellant - Dry Nitrogen
- Colour - Post office Red
- Operating Temp - -30 0C to +55 0C
- Test Pressure - 35 bar for 30 sec
- Burst pressure - 55 bar at body, 80 bar at weld
- Filling Tolerance - ± 2% by mass

- Powder coating - Pure Polyester corrosion resistant (Inside and Outside)
- Fusible bulb Temp - 68 0C
- Material
- Cylinder body - Mild Steel, IS 513
- Control valve - Brass
- Marking - As per IS 15683:2006

Gas Flooding System

A. Purpose:

This specification is for procurement of Halo carbon based clean agent gas (UL Listed) approved by NFPA 2001 latest addition or any other clean agent gas (UL Listed) approved by NFPA. It shall be used as a standard for the system Equipment, System Installation and Acceptance testing. The gas shall be as specified in the Makes of Material attached along with the tender documents.

B. Mandatory Bidding Requirements:

1. The Bidder shall be any one of the approved Global International Distributors & Original Equipment Manufacturer (OEM) for the specified makes of equipment, authorized and certified by the parent company, to manufacture and market their Fire Protection Systems. **Latest Support Letter** from the OEM should be submitted specifically for this project along with the tender.
2. Indian distributors of the certified OEMs could bid for the project, provided they furnish their **Authorization Certificate** from the OEMs. However, Authorization certificate garnered by the Indian Bidder for the exclusive purpose of participation in this tender only, or any such agreement between the Indian Bidder and an International OEM which could be implied to be on a case-to-case basis, shall not be acceptable, and such tender bids shall be summarily rejected.
3. The Indian Distributor should have executed at least (1) Projects involving the similar system for designing, supply, erection, testing and commissioning of equal volume of this project so as to qualify for this tender. Details of this project to be submitted along with the Technical bid.
4. The Bidder should have received Technical training on design; installation and commissioning of the systems from the principal, and training certificates to this account from the principals should be submitted.
5. The OEM shall give a Certificate stating that their system is approved by UL / FM for use with **Seamless Steel Cylinders (Component as well as System Approval)**.
6. The OEM shall also provide a Letter that the OEM has **Flow Calculation software suitable for Seamless Steel cylinder bidded for** as per the Bill of materials, and that such Software shall be type approved by FM / UL /ULC.

C. Specific Technical Requirements:

- 1.0 The Storage Container offered shall be of Seamless type, meant for exclusive use in the above gas systems, with FM/UL/ULC component approval. Welded cylinders are not permitted.

- 2.0 The Seamless storage cylinder shall be approved by PESO, Nagpur and shall have NOC from PESO, Nagpur for import of the same. Documentary evidence to be provided for earlier imports done by the Indian bidder.
- 3.0 Only those Cylinders whose Capacities are mentioned on the FM/UL/ ULC approval certificates of the OEMs are acceptable for this project. Any such Cylinder whose capacities are not mentioned in the FM/UL listings/ ULC approval certificates are not acceptable for this project.
- 4.0 The Valve operating actuators shall be of Electric (Solenoid) type, and it should be capable of resetting automatically/ manually.
- 5.0 The Individual Bank shall also be fitted with a manual mechanism operating facility that should provide actuation in case of electric failure.
- 6.0 The system flow calculation shall be carried out on certified software, suitable for the Seamless Steel Cylinder being offered for this project. Such system flow calculations shall be also approved by UL / FM /ULC.
- 7.0 The system flow calculation software developed for Welded Cylinder parameters, and subsequently modified to suit the Seamless Cylinder parameters, shall not be admissible.
- 8.0 Such Modified Software and System Designs shall be admissible only if the modifications too, are tested, certified and listed by UL / FM /ULC.
- 9.0 The system shall UL/FM/ ULC certified technology that allows for a higher capacity to overcome frictional losses and allow for higher distances of the agent flow; and also allow for better agent penetration in enclosed electronic equipment's such as Server Racks/ Electrical Panels etc.

D. GENERAL TECHNICAL REQUIREMENTS.

1. The designer shall consider and address possible Fire hazards within the protected volume at the design stage. The delivery of the above system shall provide for the highest degree of protection and minimum extinguishing time. The design shall be strictly as per NFPA standard NFPA 2001- 2012 edition
2. The suppression system shall provide for high-speed release of Gas based on the concept of total Flooding protection for enclosed areas. A Uniform extinguishing concentration shall be as applicable and approved by the manufacturer/NFPA 2001/UL/ULC/FM of the gases for 70 deg F, or higher as recommended by the system / agent manufacturer.
3. The system discharge time shall be 10 seconds or less, in accordance with NFPA standard 2001-2012 edition.
4. Sub floor and the ceiling void to be included in the protected volume.
5. The Fire Suppression System shall include a control system provision for both pre-alarm and automatic agent release but Aspiration detectors are already installed thus except detectors all other components will have to be considered. The system should be able to incorporate existing Aspiration detectors at site. The detection system should also be UL/ULC and FM approved.
6. The system to be supplied by the bidder must satisfy the various and all requirements of the Authority having Jurisdiction over the location of the protected area and must be in accordance with the OEM's product design criteria.
7. The discharge nozzles shall be located in the protected volume in compliance to the limitation with regard to the spacing, floor and ceiling covering etc. The nozzle locations shall be such that the uniform design concentration will be established in all

parts of the protected volumes. The final number of the discharge nozzles shall be according to the OEM's patented and certified software, which shall also be approved by third party inspectors and certifiers such as UL / FM/ULC.

8. The Gas shall be stored in seamless storage containers complying with the SMPV Rules set out by Chief Controller of Explosives, Nagpur, India. The Bidder shall be required to produce a NOC for the Chief Controller of Explosives, Nagpur for the storage containers against the cylinder identification numbers punched on them.
9. The Gas shall be discharged through the operation of an Electric (solenoid) operated device or pneumatically operated device, which releases the agent through a differential pressure valve.
10. Systems that employ explosive or pyrotechnic devices for the discharge shall not be permitted.
11. All system components shall be New and of Current Manufacture and shall be installed in accordance with local codes.
12. The Buyer, or the End user of this system or the consultant for this project reserves the Exclusive Rights to **unconditionally** reject any and all such components which may not be, or are suspected not to be of current manufacture; and / or on the grounds of authenticity of the system components and designs.
13. The Buyer of the End User of the system is also unconditionally authorized vide the above point of this specification to forfeit the Earnest money deposits and, and / or Advance Bank Guarantees / Performance Bank Guarantees and further impose of penalty as deemed fit on the vendors found not supplying authentic & current manufacture material / designs.
14. The suppression agent shall be UL/FM/ULC component recognized and the approval agent shall be filled as certified by the OEM along with Inspection Certificate of 3rd Party.
15. The bidder shall provide all documentation such as Cylinder Manufacturing Certificates. Test and Inspection Certificates and Fill Density Certificates.
16. The extinguishing system shall include the following components:
 - Agent storage container with cylinder valve, pressure gauge.
 - Gas agent.
 - Discharge nozzle(s).
 - Solenoid valve(s) and Pneumatic Actuator(s).
 - Manual Actuator(s).
 - Mounting brackets.
 - Discharge hoses.
 - Check valves,
 - Inter-connecting Actuation hoses
 - Manifolds and piping with fittings.
 - Any other required for the completeness of the system.
17. The Gas discharge shall be activated by an output directly from the Gas Release control panel, which will activate the solenoid valve. The Gas agent is stored in the container as a liquid.
18. Systems containing components that have a dated life span and must be periodically replaced shall not be acceptable.
19. The releasing of Gas Cylinder(s) shall also be possible through direct mechanical actuation, providing a means of discharge in the event of total electrical malfunction.

20. The manual release device fitted on the Gas Cylinder(s) shall be of a manual lever type and a faceplate with clear instruction of how to mechanically activate the system. In all cases, gas cylinders shall be fitted with a manual mechanical operating facility that requires two-action actuation to prevent accidental actuation.
21. Gas storage cylinders shall be provided with a safety rupture disc. An increase in internal pressure due to high temperature shall rupture the safety disc and allow the content to vent before the rupture pressure of the container is reached. The contents shall not be vented through the discharge piping and nozzles.
22. Gas containers shall be equipped with a pressure gauge to display internal pressure. The gauge shall be an integral part of the container and shall be colour-coded for fast referencing of pressure reading.
23. Aluminium/Brass Discharge nozzles shall be used to disperse the Clean gas agent.. The nozzles shall be brass/Aluminium with female threads and available in sizes as advised by the OEM system manufacturer. Each size shall come in two styles: 180° and 360° dispersion patterns. The nozzles provided shall be UL listed /ULC approved.
24. All the Major components of the Gas suppression system such as the Cylinder, Valves and releasing devices, nozzles and all accessories shall be supplied by **one single manufacturer under the same brand name and should be UL listed and UL marked.**
25. **Gas Release Panel:** The Gas release signal output shall be by a microprocessor based Intelligent/Addressable control panel with battery charger and stand-by batteries. The Panel shall have 2 x 40 character LCD display and have a capacity of 198 devices per loop .The panel should have LED indications for all zones, complete with internal sounder and alarm/fault indications The panel shall be capable of enhanced features such inbuilt printer and auto dialer interface, by addition of extra cards/ field modules on the motherboard. The panel should be UL listed.
26. Manual Gas Discharge stations and Manual Abort Stations, in conformance to the requirements put forth in NFPA 2001 shall be provided.
27. Release of Gas agent shall be accomplished by an electrical output from the Gas Release Panel to the solenoid valve and shall be in accordance with the requirements set forth in the current edition of the National Fire Protection Association Standard 2001.
28. **Acceptance Tests:** Acceptance for the System installation, inclusive of the piping and requisite cabling shall be strictly in accordance with the installation acceptance guidelines as put forth in the NFPA 2001. The bidder shall be required to carry out a simulation test [with the Electrical Solenoid on the Gas bank (/ Cylinder) disenabled / disengaged so as to prevent discharge of gas], and prove the functionality of the System.

E. SYSTEM CONSIDERATIONS AND REQUIREMENTS:
System Drawings:

The tender drawings and Schedule of Quantities enclosed are for basic guidance of the bidder. It shall be the responsibility of the individual bidder to ensure the completeness of the gas flooding system as per area and volume of the protected risk.

The Contractor shall specifically prepare shop drawings, which are to an indicated scale with lettering no smaller than one-eighth inch and easily reproducible. These

drawings will show the quantity, location, and marking of all system components. Included shall be a description and routing of all piping, wiring for detectors and conduit layouts.

Computer flow calculations using the manufacturers approved software shall detail pressure changes, flow rates, pipe and nozzles sizes.

Care should be taken to locate all agent storage containers as close to the protected area as possible to ensure complete liquid discharge of the suppression agent within 10 seconds.

System electrical schematics and diagrams shall be provided, including a description of all interlock functions.

Warranty

System shall be warranted for parts and labour for not less than a period of one (1) year from the date of installation. The Contractor shall specify the maintenance to be performed during the warranty period to maintain warranty conditions.

CODES AND STANDARDS:

NFPA 2001 (2012 ed) standard on Clean Agent Fire Extinguishing System.

SMPV Rules 1981, CCE Nagpur (for storage of cylinders)

Clean agent manufacturer's recommendation.

National Building Code of India and TAC rules.

F. MANDATORY APPROVALS/CERTIFICATES TO BE PROVIDED BY BIDDER ALONG WITH THE TECHNICAL BID.

1. All the Major components of the Gas suppression system such as the Cylinder, Valves and releasing devices, nozzles and all accessories shall be supplied by **one single manufacturer under the same brand name and should be UL listed and UL marked.**
2. **Cylinders** : The cylinders should be seamless & PESO approved. (Dates of approval and manufacture should not be more than 6 months old.)
3. **Gas filling station**: should be UL and PESO approved, and **if required**, will be inspected by the Engineer-in-Charge/Architect/Consultants/their representative.
4. **Letter from the OEM specifically for this project**- This Letter should be declaration saying that the OEM's hardware, Gas and software to be supplied in the tender is UL/FM/ULC listed .The Bidder should have got necessary training from the OEM.
5. The system should be **42 bar system only**.
Software used for Calculations should be UL Listed.

Commissioning and Guarantees (Plumbing System)

1 Scope of work

Work under this section shall consist of pre-commissioning, commissioning, testing and providing guarantees for all equipment, appliances and accessories supplied and installed by the contractor under this contract.

2 General requirements:

- 2.1 The rates quoted in this tender shall be inclusive of the works given in this section.
- 2.2 Contractor shall provide all tools equipment, metering and testing devices required for the purpose.
- 2.3 On award of work, contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

3 Pre-commissioning

- 3.1 On completion of the installation of all pumps, piping, valves, pipe connections, and water level controlling devices, the contractor shall proceed as follows: -

A Water Supply System:

- i) Check all control valves and close if any valve is open. Also check all suction and delivery connections are properly made.
- ii) Test run and check rotation of each motor and correct the same if required.

B Pipe work

- i) Check all clamps, supports and hangers provided for the pipes.
- ii) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specifications. If any leakage is found, rectify the same and retest the pipes.

B. Handing Over

- 1) All commissioning and testing shall be done by the contractor to the complete satisfaction of the Engineer-in-Charge, and the job handed over to the Engineer-in-Charge, or his authorized representative.
- 2) Contractor shall also hand over, to the Engineer-in-Charge, all maintenance & operation manuals and all other items as per the terms of the contract.

Commissioning and Guarantees (Fire Fighting System)

1 Scope of work

Work under this section shall consist of pre-commissioning, commissioning, testing and providing guarantees for all equipment, appliances and accessories supplied and installed by the contractor under this contract.

2 General requirements:

- 2.1 The rates quoted in this tender shall be inclusive of the works given in this section.
- 2.2 Contractor shall provide all tools equipment, metering and testing devices required for the purpose.
- 2.3 On award of work, contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

3 Pre-commissioning

3.1 On completion of the installation of all pumps, piping, valves, pipe connections, and water level controlling devices, the contractor shall proceed as follows:-

A Fire protection system:

- i) Check all hydrant valves and close if any valve is open. Also check all suction and delivery connections are properly made.
- ii) Test run and check rotation of each motor and correct the same if required.

B Pipe work

- i) Check all clamps, supports and hangers provided for the pipes.
- ii) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specifications. If any leakage is found, rectify the same and retest the pipes.

4 Commissioning & Testing

A. Fire hydrant system

- i) Pressurize the fire hydrant system by running the main Electric Driven fire pump and after attaining the required pressure shutoff the pump.
- ii) Open hydrant valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump should cut-in at the pre-set pressure and should not cutout automatically on reaching the normal line pressure. The fire pump should stop only by manual push button.
- iii) Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump.
- iv) When the fire pumps have been checked for satisfactory working on automatic controls, open five hydrant valves simultaneously and allow the hose pipes to discharge water into the fire tank to avoid wastage. The electrically driven pump should run continuously for eight hours so that its performance can be checked.
- v) Check each landing valve, male and female couplings and branch pipes for compatibility with each other. Any fitting which is found to be incompatible and does not fit into the other properly shall be replaced by the contractor. Landing valves shall also be checked by opening and closing under pressure.

B. Handing over

- 1) All commissioning and testing shall be done by the contractor to the complete satisfaction of the Engineer-in-Charge, and the job handed over to the Engineer-in-Charge, or his authorized representative.
- 2) Contractor shall also hand over, to the Engineer-in-Charge, all maintenance & operation manuals and all other items as per the terms of the contract.

NIT No- AGIHF/Executing Agency/2024-25/01 date 27.08.2024

SCHEDULE OF ITEMS FOR SANITARY, PLUMBING & FIRE FIGHTING WORKS

S.No.	Description of Item
1.0	Sanitary Fixtures & CP Brass Fittings
1.1	Providing and fixing water closet squatting pan (Indian type W.C. pan) with 100 mm sand cast Iron P or S trap, 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever) conforming to IS : 7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required:
1.1.1	White Vitreous china Orissa pattern W.C. pan of size 580x440 mm with integral type foot rests
1.2	Providing and fixing Stainless Steel A ISI 304 (18/8) kitchen sink as per IS 13983 with C.I. brackets and stainless steel plug 40 mm including painting of fittings and brackets, cutting and making good the walls wherever required :
1.2.1	Kitchen sink with drain board 510x1040 mm, bowl depth 200mm.
1.2.2	Kitchen sink without drain board 610x510 mm, bowl depth 200mm.
1.3	Providing and fixing white Poly propylene (PP) sink with C.I bracket, C.P. brass chain with rubber plug, 40 mm C.P. brass waste Jaquar Cat. No. ALD-727 or equivalent from approved make list, including painting of fitting and brackets, cutting and making good the wherever required:
1.3.1	600x450x250mm
1.4	Providing and fixing P.V.C. Waste pipe for sink or wash basin including P.V.C. waste fittings complete.
1.4.1	Semi rigid pipe
1.4.1.1	40 mm dia.
1.5	Providing, fixing, testing & commissioning of white Vitreous china wall hung European type water closet with P trap, with lid , seat cover with CP bolts, nuts, concealed cistern with Face plate ,CP brass hinges and rubber buffers , WC pan connector / flush pipe with clamp and adapter rubber joint & necessary fittings screws and washers complete including cutting and making good the walls and floors where required.
1.5.1	Wall Hung WC with seat cover Jaquar Cat.No.KUS-WHT-35953 + WC Connector Kohler Model - K-1046327-S + Concealed Flushing Cistern JCS-WHT-2400WS+Face Plate for Cistern Jaquar Cat. No. JCP-CHR-852415+ Chair Bracket Kohler Model-K-1225108-0 or equivalent from approved make list. (Guest House & Private Ward of Hospital).

1.5.2	Wall Hung WC with seat cover Jaquar Cat.No.FLS-WHT-5953 + WC Connector Kohler Model - K-1046327-S + Concealed Flushing Cistern Jaquar Cat. No. JCS-WHT-2400S+Face Plate for Cistern Jaquar Cat. No. JCP-CHR-852415+ Chair Bracket Kohler Model-K-1225108-0 or equivalent from approved make list. (All Other Buildings)
1.6	Providing and fixing white vitreous china wash basin with special fabricated brackets painted white, faucets as required, 32 mm C.P. brass waste.32 mm C.P. brass bottle trap & pipe to wall with rubber adopter for waste connection and C.P. brass wall flange complete in all respects including cutting and making good the walls where required.
1.6.1	Wash basin Jaquar Cat. No. FLS-WHT-5931 , 32 mm CP brass waste Jaquar Cat. No. ALD-727, 32 mm C.P. brass bottle trap with pipe to wall and C.P. wall flange Jaquar Cat. No. ALD-769L300x190 or equivalent from approved make list. (Guest House, Private Ward of Hospital & Wherever Flat Back Wash Basin Required) .
1.6.2	Wash basin Jaquar Cat. No. FNS-WHT-40701 or Jaquar Cat. No. FLS-WHT-5701 , 32 mm CP brass waste Jaquar Cat. No. ALD-727, 32 mm C.P. brass bottle trap with pipe to wall and C.P. wall flange Jaquar Cat. No. ALD-769L300x190 or equivalent from approved make list. (All Other Buildings)
1.7	Providing and fixing 15mm C.P brass Single Lever Basin Mixer Jaquar Cat. No. KUP-35011BPM or equivalent from approved make list for Wash Basin Including cutting and making good the walls wherever required (Guest House, Private Ward of Hospital) .
1.8	Providing and fixing 15mm C.P brass Single Lever Basin Mixer Jaquar Cat. No. FLR-5001B or equivalent from approved make list for Wash Basin Including cutting and making good the walls wherever required (All Other Buildings) .
1.9	Providing and fixing 15mm C.P brass Touchless Basin Mixer Euronics Cat. No. ET02HC or equivalent from approved make list for Wash Basin Including cutting and making good the walls wherever required. (Critical Areas of Hospital) .
1.10	Providing and fixing 15mm C.P brass Pillar Faucet Jaquar Cat. No. FLR-5015 or equivalent from approved make list for Wash Basin Including cutting and making good the walls wherever required (All Other Buildings) .
1.11	Providing and fixing 15mm C.P. copper connecting pipe 450mm long with C.P. brass nuts, washers complete in all respects.(Jaquar Cat No. ALD 803AB or equivalent from approved make list)
1.12	Providing & Fixing vitreous china urinal basin Jaquar Cat. No. URS-WHT-13255 + Jaquar Cat. No. SNR-CHR-51097 or equivalent from approved make list with C.I. Hangers, comprising of electronic & electrical items including infrared photo cells eyes, electronically operated solenoid valve, step down equipment, electric operated, concealed piping etc. & any other item required to provide satisfactory functioning, 32 mm CP brass waste Jaquar Cat. No. ALD-727, 32 mm C.P. brass bottle trap with pipe to wall and C.P. wall flange Jaquar Cat. No. ALD-769L300x190 or equivalent from approved make list complete including cutting and making good the walls and floors where required. (All Other Buildings) .

1.13	Providing & Fixing vitreous china urinal basin Jaquar Cat. No. URS-WHT-132530 or equivalent from approved make list with Self Closing Angle Valve for Urinal Flushing Jaquar Cat. No. PRS-073 or equivalent from approved make list including C.I. Hangers, 32 mm CP brass waste Jaquar Cat. No. ALD-727, 32 mm C.P. brass bottle trap with pipe to wall and C.P. wall flange Jaquar Cat. No. ALD-769L300x190 or equivalent from approved make list complete including cutting and making good the walls and floors where required. (Resident Hostel).
1.14	Providing and fixing C.P. brass 15 mm nominal bore two way bib cock Jaquar Cat. No. KUP-35041PM or equivalent from approved make list. (Guest House, Private Ward of Hospital).
1.15	Providing and fixing C.P. brass 15 mm nominal bore two way bib cock Jaquar Cat. No. FLR-5041N or Equivalent. (All Other Buildings).
1.16	Providing and fixing C.P. brass 15 mm nominal bore one way bib cock Jaquar Cat. No. KUP-35037PM or equivalent from approved make list (Guest House, Private Ward of Hospital).
1.17	Providing and fixing C.P. brass 15 mm nominal bore one way bib cock Jaquar Cat. No. FLR-5047N or equivalent from approved make list. (All Other Buildings).
1.18	Providing and fixing C.P. brass 15mm nominal bore angle valve Jaquar Cat. No. KUP-35053PM or equivalent from approved make list for basin mixer and geyser points (Guest House, Private Ward of Hospital).
1.19	Providing and fixing C.P. brass 15mm nominal bore angle valve Jaquar Cat. No. FLR-5053N or equivalent from approved make list for basin mixer and geyser points (All Other Buildings).
1.20	Providing and fixing C.P. cast brass twin coat hooks fixed to PVC rawl plug with SS screws Jaquar Cat. No. AKP-35761P or equivalent from approved make list. (All Buildings).
1.21	Providing and fixing health faucet with 1 m long flexible tube and wall hook including all fittings Jaquar Cat. No. ALD-577 or equivalent from approved make list. (All Buildings).
1.22	Providing and fixing 15mm C.P brass Sink Mixer Jaquar Cat. No. FLR-5165 or equivalent from approved make list.) for kitchen sink with swinging spout complete. Including cutting and making good the walls wherever required (All Buildings).
1.23	Providing and fixing of C.P. brass 600 mm size towel rail Jaquar Cat. No. AKP-35711P or equivalent from approved make list fixed with C.P. brass screws complete in all respects (All Buildings).
1.24	Providing and fixing of C.P. brass Soap Dish Make Jaquar Cat.No.AKP-35731P or equivalent from approved make list fixed with C.P. brass screws complete in all respects (All Building).
1.25	Providing and fixing C.P brass toilet paper holder Jaquar Cat. No. AKP-35753P or approved equivalent from approved make list, Including cutting and making good the walls wherever required (Guest House, Private Ward of Hospital).

1.26	Providing and fixing C.P brass toilet paper holder Jaquar Cat. No. AKP-35751P or approved equivalent from approved make list, Including cutting and making good the walls wherever required (All Building) .
1.27	Providing and fixing liquid dispenser including all fittings complete Euronics Cat No. ES06N or equivalent from approved make list, Including cutting and making good the walls wherever required (Guest House, Private Ward of Hospital) .
1.28	Providing and fixing liquid dispenser including all fittings complete Euronics Cat No. ES-31 or equivalent from approved make list, Including cutting and making good the walls wherever required (All Building) .
1.29	Providing and fixing Swing Handicap Grab Bar Euronics Cat No. EGR-S02 or equivalent from approved make list, Including cutting and making good the walls wherever required (All Building) .
1.30	Providing and fixing Grab Rail 600 mm Euronics Cat No. EGR-01 or equivalent from approved make list, Including cutting and making good the walls wherever required (All Building) .
1.31	Providing and fixing 60 litre/ hr. cooling and 80 Litres storage capacity, fully stainless steel electric storage type water cooler (Blue Star model No. SDLX 680 or equivalent from approved make list) with inlet hose connection inbuilt float valve. 2 Nos. outlet faucet, drain tray with waste and pipe up to floor trap heavy compressor and wire up to socket, 3 pin plug etc. complete in all respect.
1.32	Supplying, installation, testing and commissioning of skid mounted fully automatic Reverse Osmosis System of output capacity 50 litres / hour designed at a minimum Flux at inlet complete as required.
1.33	Providing and Fixing of C.P. Brass Shower set comprising of :
	One No. CP brass Wall Mixer Jaquar Cat. No. FLR-5273UPR or equivalent from approved make list.
	One No. CP brass OH shower head & Shower Arm Jaquar Cat.No.OHS-1799 + Jaquar Cat.No.SHA-483 or equivalent from approved make list.
	Including cutting and making good the walls wherever required.
	Shower set as described above (All Other Buildings) .
1.34	Providing and Fixing of C.P. Brass Shower set comprising of :
	One No. CP brass Concealed Sower Mixer Diverter Jaquar Cat. No. KUP-35079KPM + ALD-079 or equivalent from approved make list.
	One No. CP brass OH shower head & Shower Arm Jaquar Cat. No. OHS-1709 + Jaquar Cat. No. SHA-455L400 or equivalent from approved make list.
	One No. CP brass Bath Spout Jaquar Cat. No. SPJ-35429PM or equivalent from approved make list.
	Including cutting and making good the walls wherever required.
	Shower set as described above (Guest House, Private Ward of Hospital) .

1.35	Providing and fixing fully automatic Hand dryer Euronics Model-EH 26 NW or equivalent from approved make list ,including all fittings complete in all respect (All Buildings) .
1.36	Providing and fixing of C.P. brass towel ring Jaquar Cat. No. AKP-35721P or equivalent from approved make list fixed with C.P. brass screws complete in all respects (All Building) .
2.0	Soil, Waste, Vent & Rain Water Pipes
2.1	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering. All work up to plinth.
2.1.1	1:2:4 (1cement : 2 Coarse sand : 4 graded stone aggregate 20 mm nominal size)
2.2	Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1mx1mx400micron, finished with 12mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.
2.3	Providing and fixing to the inlet mouth of rain water pipe cast iron grating 15 cm diameter and weighing not less than 440 grams.
2.4	Providing and fixing sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, food safe, high impact and stiffness as per ON EN 1451-1 and DIN 19560 offering sound levels of not more than 21 dBA at a flow rate of 4 l/s and having pipe ring stiffness as per IS / DIS 9969 and tightness as per EN 1277 / B and C and DIN 19560, with all necessary fittings in blue colour as per ON EN 1451-1 and DIN 19560 all fitted with factory fitted lip ring.
2.4.1	40 mm OD
2.4.2	63 mm OD
2.4.3	75 mm OD
2.4.4	110 mm OD
2.4.5	160 mm OD
2.5	Providing and fixing Polypropylene (PP) P-Trap including setting with cement concrete 1:2:4 (1 cement : 2 coarse sand: 4 hand stone ballast 20 MM nominal size) the inlet from floor level to trap rim to be grouted and cemented neat manner including cutting and making good the floor & wall wherever required complete in all respects
2.5.1	110 mm inlet and 110 mm outlet
2.6	Providing and fixing 110 OD x 600mm PP fitting with 2 & 3 nos. PP. Socket 32 & 40 and 50mm rodding eye complete in all respect.
2.6.1	110 OD Pipe
2.7	Providing and fixing PP cleanout plug fixed to PP Pipe complete in all complete including cutting and making good the walls and floor wherever required
2.7.1	110 OD Pipe

2.7.2	160 OD Pipe
2.8	Providing and fixing uPVC agricultural pipes conforming to IS:4985 (6 kg/sqcm) including all fittings, e.g. couplings, tees, bends, reducers and screwed adaptors jointing with solvent cement joint as per manufacturers' recommendations. [for Rain Water Pipes]
2.8.1	90 mm OD
2.8.2	110 mm OD
2.8.3	160 mm OD
2.9	Providing and fixing of GI clamps with EPDM rubber lining Zinc plated for support of vertical soil, waste, vent and rain water pipes, embedded in walls with anchor fastener etc. including cost of cutting holes and making good the walls complete in all respects.
2.9.1	For 75 mm OD Pipe
2.9.2	For 110 mm OD Pipe
2.9.3	For 160 mm OD Pipe
2.10	Providing and fixing in position 11x63 mm OD PP reducing elbow including fix to floor with cement mortar.
2.11	Providing and fixing in position 125x125 mm stainless steel grating for floor trap/floor drain including fix to floor with cement mortar.
2.12	Providing & Fixing of Multi Trap Hight adjustment extension piece 110 x 150mm long upto floor level complete. (Make : Viega, Article Code : 111496)
2.13	Providing and fixing in position 110x63 mm dia uPVC Balcony Drain including fix to floor with cement mortar.
3.0	Water Supply System
3.1	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of Engineer in Charge.
	Concealed work including cutting chases and making good the walls etc.
3.1.1	20 mm nominal outer dia .Pipes.
3.1.2	25 mm nominal outer dia .Pipes.
3.1.3	32 mm nominal outer dia .Pipes.
3.2	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge.
	Internal Work - Exposed on Wall
3.2.1	20 mm nominal outer dia .Pipes.

3.2.2	25 mm nominal outer dia .Pipes.
3.2.3	32 mm nominal outer dia .Pipes.
3.2.4	40 mm nominal outer dia .Pipes.
3.2.5	50 mm nominal outer dia .Pipes.
3.2.6	65 mm nominal outer dia .Pipes. Sch-40
3.2.7	80 mm nominal outer dia .Pipes. Sch-40
3.2.8	100 mm nominal outer dia .Pipes. Sch-40
3.2.9	150 mm nominal outer dia .Pipes. Sch-40
3.3	Constructing masonry Chamber 30x30x50 cm inside, in brick work in cement mortar 1:4 (1 cement :4 coarse sand) for stop cock, with 300 X 300 mm inside dimension FRP cover with frame fixed in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12mm thick, finished with a floating coat of neat cement complete as per standard design :
3.3.1	With common burnt clay F.P.S.(non modular) bricks of class designation 7.5
3.4	Constructing masonry Chamber 60x60x75 cm inside, in brick work in cement mortar 1:4 (1 cement : 4 coarse sand) for sluice valve, with 600 X 600 mm inside dimension FRP cover with frame fixed in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick, finished with a floating coat of neat cement complete as per standard design :
3.4.1	With common burnt clay F.P.S.(non modular) bricks of class designation 7.5
3.5	Providing and fixing forged brass ball valve of brass body with hard chrome plated steel ball inside PTFE (Teflon) seat & ring with chrome plated centre handle with female BSP threads complete in all respects.
3.5.1	20 mm nominal bore
3.5.2	25 mm nominal bore
3.5.3	32 mm nominal bore
3.5.4	40 mm nominal bore
3.5.5	50 mm nominal bore
3.6	Supplying, fixing, testing and commissioning of butterfly valve of PN 1.6 rating with bronze/gunmetal seat duly ISI marked complete with nuts, bolts, washers, gaskets conforming to IS 13095 of following sizes as required :
3.6.1	65 mm dia
3.6.2	80 mm dia
3.6.3	100 mm dia
3.6.4	150 mm dia
3.7	Providing and fixing Thermoflex or Kaiflex thermal insulation tubing a elastomeric flexible material having hermetic blister closed cell structure of expanded synthetic rubber over pipes of following nominal bores and thickness including all required accessories complete as per specification.
	6 mm thick (Concealed Pipes)

3.7.1	For 20 mm dia Pipe
3.7.2	For 25 mm dia Pipe
3.7.3	For 32 mm dia Pipe
3.8	Providing and fixing Thermoflex or Kaiflex thermal insulation tubing, a elastomeric flexible material having hermetic blister closed cell structure of expanded synthetic rubber over pipes of following nominal bores and thickness including protection by IC Clad covering (reinforced glass fibre fabric) all required accessories complete as per specification.
	9 mm thick (Exposed in Shafts)
3.8.1	For 20 mm dia Pipe
3.8.2	For 25 mm dia Pipe
3.8.3	For 32 mm dia Pipe
3.8.4	For 40 mm dia Pipe
3.8.5	For 50 mm dia Pipe
3.8.6	For 65 mm dia Pipe
3.9	Providing and fixing Thermoflex or Kaiflex thermal insulation tubing, a elastomeric flexible material having hermetic blister closed cell structure of expanded synthetic rubber over pipes of following nominal bores and thickness including protection by wrapping with 24 gauge aluminium sheet with riveted screw joints all required accessories complete as per specification.
	13 mm thick (Exposed at Terrace)
3.9.1	For 20 mm dia Pipe
3.9.2	For 25 mm dia Pipe
3.9.3	For 32 mm dia Pipe
3.9.4	For 40 mm dia Pipe
3.9.5	For 50 mm dia Pipe
3.9.6	For 65 mm dia Pipe
3.10	Providing and fixing forged brass single acting air release valve with screwed inlet 25 mm dia.
3.11	Providing and fixing of Single phase electrical actuator operated wafer type rubber lined butterfly valve with by-pass arrangement as per drawing attached including level controller, 3 nos. normal butter fly valves, necessary control and Power cables (Maximum 10 M. Length of each type) and control panel installed on OH tank filling line near the tanks complete in all respects.
3.11.1	32 mm dia.
3.11.2	40 mm dia.
3.11.3	50 mm dia.
3.11.4	65 mm dia.
3.12	Supplying, installation, testing and commissioning of skid mounted fully automatic Reverse Osmosis System of output capacity 1200 litres / hour designed at a minimum Flux at inlet complete as required with the following items:

	Garnet Filter (GF) - 1 No.
	Media for GF - 1 LOT
	Antiscalant Dosing System with level sensors - 1 Lot
	Cartridge Filter - 1 No.
	High pressure pump - 2 Nos (1W + 1St).
	R.O. Block - 1 No.
	Membranes - As per manufacturer design
	Pressure Tubes - 1 No.
	RO skid - 1 No.
	pH correction system - 1 No.
	Necessary instruments - 1 Lot
	Interconnecting pipe with necessary valve work - 1 Lot
	PVC (upto HP Pump) - 1 Lot
	SS (HP Pump to Membrane) - 1 Lot
	Pressure gauges - 5 Nos.
	Rotameter - 2 Nos.
	PPLC cum instrument panel - 1 No.
	Conductivity Indicator - 1 No.
	Level sensors (Anti scalent Tank) - H/L
	Level sensors (Permeate Tank) - H/L
	Solenoid Valve (Inlet) to R.O. tank - 1 No.
	Solenoid Valve (Reject) - 1 No.
	The reverse osmosis block shall be duly supplemented with adequate pre-treatment and post treatment equipment such as filter sodium metabisulphate dosing, anti-scalant dosing and post RO treatment pH correction dosing etc. in line with the raw water characteristics and the required treated water parameters. The plant should consist of the following automation:
	The plant starts when the level at R.O. water storage tank is low and stops when the level at R.O. water storage tank is high.
	When the level is low, the raw water pump starts. High pressure pumps starts after two minutes of starting of raw water pump.
	The reject valve closes after 1 minute of starting of high pressure pump.
	If the pressure at high pressure pumps suction is low / high, the plant trips.
	When the plant stops due to high level, first the high pressure pump stops and the dump valves opens, after two minutes the raw water pumps and dosing pump stops.
	When the connectivity is high an alarm is given.
	The MIMIC provides indications for all the I/Ps and the respective O/Ps.
	R.O. plant as described above
3.13	Supplying, installation, testing and commissioning of skid mounted fully automatic Reverse Osmosis System of output capacity 75 litres / hour designed at a minimum Flux at inlet complete as required with the following items:

	Garnet Filter (GF) - 1 No.
	Media for GF - 1 LOT
	Antiscalant Dosing System with level sensors - 1 Lot
	Cartridge Filter - 1 No.
	High pressure pump - 2 Nos (1W + 1St).
	R.O. Block - 1 No.
	Membranes - As per manufacturer design
	Pressure Tubes - 1 No.
	RO skid - 1 No.
	pH correction system - 1 No.
	Necessary instruments - 1 Lot
	Interconnecting pipe with necessary valve work - 1 Lot
	PVC (upto HP Pump) - 1 Lot
	SS (HP Pump to Membrane) - 1 Lot
	Pressure gauges - 5 Nos.
	Rotameter - 2 Nos.
	PPLC cum instrument panel - 1 No.
	Conductivity Indicator - 1 No.
	Level sensors (Antiscalant Tank) - H/L
	Level sensors (Permeate Tank) - H/L
	Solenoid Valve (Inlet) to R.O. tank - 1 No.
	Solenoid Valve (Reject) - 1 No.
	The reverse osmosis block shall be duly supplemented with adequate pre-treatment and post treatment equipment such as filter sodium metabisulphate dosing, anti-scalant dosing and post RO treatment pH correction dosing etc. in line with the raw water characteristics and the required treated water parameters. The plant should consist of the following automation:
	The plant starts when the level at R.O. water storage tank is low and stops when the level at R.O. water storage tank is high.
	When the level is low, the raw water pump starts. High pressure pumps starts after two minutes of starting of raw water pump.
	The reject valve closes after 1 minute of starting of high pressure pump.
	If the pressure at high pressure pumps suction is low / high, the plant trips.
	When the plant stops due to high level, first the high pressure pump stops and the dump valves opens, after two minutes the raw water pumps and dosing pump stops.
	When the connectivity is high an alarm is given.
	The MIMIC provides indications for all the I/Ps and the respective O/Ps.
	R.O. plant as described above

3.14	Supply, installation, testing and commissioning of stainless steel R.O water storage tank (SS 316) with minimum thickness of shell is 3 mm and base is 3 mm placed at terrace level with inlet, outlet, overflow connection complete with 25 mm dia bend for vent, ball valve for scour, mosquito proof brass overflow grating and 450 mm dia manhole cover with lockable arrangement complete as per direction of Project Manager.
3.14.1	6000 Litres Capacity
3.14.2	500 Litres Capacity
3.15	Providing and fixing threaded end brass digital water meter complete in all respect.
3.15.1	32 mm dia.
3.15.2	40 mm dia.
3.15.3	50 mm dia.
3.15.4	65 mm dia.
3.15.5	80 mm dia.
3.16	Supply, installation , testing & commissioning of Micro Processor Controlled air cooled Heat pump delivering actual capacity as per the following parameters duly installed at site.
	Heat pumps shall be rated at 1.8 KW of input power and 6.0 KW of output power. Refrigerant used should be environment friendly R-410a. Heat pump should heat water upto 55°C on heat pump mode. It shall have silent operation and the sound level should not exceed 65 dB.
	Refrigerant
	R-410a (Refrigerant)
	Heat Pump as described above
	Nominal Input Power - 1.7 KW
	Output Heating capacity - 6.0 kW
	Heat pump shall have LCD display control panel with built in diagnostic and troubleshooting information
	Heat pump should have an inbuilt cycle for defrosting in case icing occurs on evaporator. with inbuilt tube in tube type heat exchanger.
	All other mounting ,fitting and controls
	Suitable for electric supply of 220 +/- 10 % volts & 1N~ 50 hz
	All interconnecting wiring/cablings between heat pump and electric panel & control valves, NRV, Piping etc complete.
	The heat pump shall have an in-built facility to start /stop depending on variation in demand at different periods.
3.17	Supply, installation , testing & commissioning of Micro Processor Controlled air cooled Heat pump delivering actual capacity as per the following parameters duly installed at site.
	Heat pumps shall be rated at 6.02 KW of input power and 19.8 KW of output power. Refrigerant used should be environment friendly R-410a. Heat pump should heat water upto 55°C on heat pump mode. It shall have silent operation and the sound level should not exceed 65 dB.
	Refrigerant
	R-410a/3.0 kg/cm2 (Refrigerant)
	Heat Pump as described above
	Nominal Input Power - 6.02 KW
	Output Heating capacity - 19.8 kW

	Heat pump shall have LCD display control panel with built in diagnostic and troubleshooting information
	Heat pump should have an inbuilt cycle for defrosting in case icing occurs on evaporator. with inbuilt tube in tube type heat exchanger.
	All other mounting ,fitting and controls
	Suitable for electric supply of 380 +/- 10 % volts & 3N~ 50 hz
	All interconnecting wiring/cablng between heat pump and electric panel & control valves, NRV, Piping etc complete.
	The heat pump shall have an in-built facility to start /stop depending on variation in demand at different periods.
3.18	Supply, installation , testing & commissioning of Micro Processor Controlled air cooled Heat pump delivering actual capacity as per the following parameters duly installed at site.
	Heat pumps shall be rated at 18 KW of input power and 70 KW of output power. Refrigerant used should be environment friendly R-410a. Heat pump should heat water upto 55°C on heat pump mode. It shall have silent operation and the sound level should not exceed 65 dB.
	Refrigerant
	R-410a/6.3 kg,/cm2 (Refrigerant)
	Heat Pump as described above
	Nominal Input Power - 21.5 KW
	Output Heating capacity - 70 kW
	Heat pump shall have LCD display control panel with built in diagnostic and troubleshooting information
	Heat pump should have an inbuilt cycle for defrosting in case icing occurs on evaporator. with inbuilt tube in tube type heat exchanger.
	All other mounting ,fitting and controls
	Suitable for electric supply of 380 +/- 10 % volts & 3N~ 50 hz
	All interconnecting wiring/cablng between heat pump and electric panel & control valves, NRV, Piping etc complete.
	The heat pump shall have an in-built facility to start /stop depending on variation in demand at different periods.
3.19	Design, Supply, installation, testing & commissioning of SS 316L horizontal hot water storage tank with 4 mm thickness suitable for minimum 5 Kg /Sqm working pressure. Tank shall be provided with water flow meter at inlet (approved by department of weights and measures), inlet / outlet, overflow / drain connection with MH cover 6 mm thick SS tank, pressure relief valves, pressure gauge at inlet / outlet with isolation cock, thermometer at inlet / outlet. All the valves & accessories shall be suitable for an operating pressure of 5 Kg/sq.cm.
	Tank shall be insulated with 100 mm thick glass wool / rock wool insulation 80 kg/m2 density, including 24 gauge aluminium cladding. Tank shall provided with 15 mm dia testing spout with valve (inlet temperature to hot water storage tank 60-65 deg.C). The flanges shall be machined from SS-316 sheets with dimensions confirming to ANSI, B 16.5 No. 150. The nozzles shall be SS pipes. (Tank shall be fabricated as per unfired pressure vessel code IS 2825-1969, IS 226 / IS 2062).
3.19.1	1000 Litres Capacity
3.19.2	2500 Litres Capacity
3.19.3	3000 Litres Capacity

3.19.4	7500 Litres Capacity
3.20	Supply, installation , testing & commissioning of following pumps suitable for 415 Volts connected with T.E.F.C. induction motor, M.S.channel, base plate complete with vibration isolators, isolating valve on suction and discharge, non-return valve on discharge, pressure gauges with stop cock and dial type thermometer on suction or discharge. The pump shall have mechanical seal. The pump shall be SS casing, impeller, shaft and CI (Epoxy coated) base & EPDM Mechanical seal (suitable for hot water temperature up to 85 deg C.) including Valves, NRV, Strainers, Pressure Gauge, Thermometer & Cabling etc. complete in all respects.
3.20.1	Hot Water circulation Pumps in Heat pump and tank. (For 19.8 KW Heat Pump) Primary & Secondary Side.
	Pump (2 Nos. 1W+1SB)
	Flow - 3.8 m3/hr
	Head - 20 mtrs
3.20.2	Hot Water circulation Pumps in Heat pump and tank. (For 70 KW Heat Pump) Primary Side.
	Pump (2 Nos. 1W+1SB)
	Flow - 12.4 m3/hr
	Head - 25 mtrs
3.20.3	Hot Water circulation Pumps in Heat pump and tank. (For 70 KW Heat Pump) Secondary Side.
	Pump (2 Nos. 1W+1SB)
	Flow - 26.5 m3/hr
	Head - 25 mtrs
3.20.4	Hot Water Return Pumps
	Pump (2 Nos. 1W+1SB)
	Flow - 1.0 LPS
	Head - 18-20 mtrs
3.21	Supply, installation, testing & commissioning of Plate Type Heat Exchanger (PHE) with SS-316L Plates including all Necessories fittings.
3.21.1	Capacity 18920 K Cal./Hr for 20 KW Heat Pump
3.21.2	Capacity 132500 K Cal./Hr for 70 KW Heat Pump
3.22	Solar Water Heating System : Supply, installation, testing & commissioning of solar water heating system consisting of ISI Marked solar flat plate type collectors 6 nos of size 2 x 1 mtr approx., laser or ultrasonic welded of area 2 M ² with necessary MS stands, supports, rubber EPDM gaskets with nut & bolts, rubber gasket for flanges, Clamps etc. including with coiled type heat exchanger. with heat exchanger of suitable surface area with necessary make up tank, necessary piping's between solar panels & solar hot water tank including one no temperature gauge, two nos ball valves. The system shall be capable to produce hot water 55 to 60 deg on clear sunny days and the efficiency of collectors should not be less than 72%.

3.23	Supply, installing, testing and commissioning of fixed speed Hydropneumatic system mounted on a common base plate comprising of vertical inline multistage pumping set with Stainless steel-304 body, Stainless steel-304 impeller, Stainless steel-304 casing, shaft of Stainless steel-316 and C.I. base & head with mechanical seal, shaft directly coupled to a TEFC induction motor suitable for 400/440 volts, 3 phase, 50 cycles AC supply with 150 mm dia pressure gauge with gunmetal isolation cock, vibration eliminating pads under foundation, dry running Protection, motor control centre, necessary power and control cabling from MCC to pumps including required rating of MCB, one No. 60 litre capacity M.S diaphragm tank with interchangeable butyl rubber membrane, dual type pressure switch, complete in all respects including suction and delivery headers of Stainless steel-316 grade pipe of required dia, isolation valves, NRV of PN-25 grade & vibration eliminators on both suction & delivery side of pumps, power box, equipped with fuses/ isolators/circuit breakers as required.
3.23.1	For Domestic Water Supply at Hospital Terrace Level
	Set of Two Pump (1 Working + Standby)
	Capacity - 3.5 LPS
	Head - 25.0 M.
	H.P. - 2.0 HP (Approx.)
3.23.2	For Domestic Water Supply for Nurse Hostel & Resident Hostel at Terrace Level
	Set of Two Pump (1 Working + Standby)
	Capacity - 2.0 LPS
	Head - 25.0 M.
	H.P. - 1.5 HP (Approx.)
3.23.3	For Domestic Water Supply for 2 BHK & 3 BHK Housing at Terrace Level
	Set of Two Pump (1 Working + Standby)
	Capacity - 1.5 LPS
	Head - 25.0 M.
	H.P. - 1.0 HP (Approx.)
4.0	Fire Fighting System
4.1	Supplying, installation, testing and commissioning of electric driven terrace pump suitable for automatic operation and consisting of following, complete in all respects, as required: (Terrace Pump)
	Horizontal type, multistage, centrifugal, split casing pump of cast iron body & bronze impeller with stainless steel shaft, mechanical conforming to IS : 1520
	Suitable HP squirrel cage induction motor TEFC type suitable for operation on 415 volts, 3 phase, 50 Hz, AC supply with IP55 class of protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS-325.
	M.S.fabricated common base plate, coupling, coupling guard, foundation bolts etc.as required.
	Suitable cement concrete foundation duly plastered and with anti-vibration pads.
4.1.1	900 LPM at 35 m Head

4.2	Providing laying, testing & commissioning of Ductile Iron class K-9 Pipe conforming to IS 8329 i/c Ductile Iron fittings class K-12 conforming to IS 9523 like elbows, tees, flanges, tapers, nuts bolts, gaskets etc. in ground including push-on-joints, excavation & providing cement concrete blocks as supports, refilling the trench etc. of following sizes complete as required.
4.2.1	100 mm dia.
4.3	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like elbows, tees, flanges, tapers, nuts bolts, gaskets etc. and fixing the pipe on the wall/ceiling with suitable clamp/support frame and painting with two or more coats of synthetic enamel paint of required shade complete as required :
4.3.1	25 mm dia
4.3.2	32 mm dia
4.3.3	40 mm dia
4.3.4	50 mm dia
4.3.5	65 mm dia
4.3.6	80 mm dia
4.3.7	100 mm dia
4.3.8	150 mm dia
4.4	Providing, laying, testing & commissioning of 'B' class heavy duty G.I. pipe conforming to IS 1239 including welding, fittings like elbows, tees, flanges, tapers, nuts, bolts, gaskets etc. and fixing the pipe on the wall/ceiling with suitable clamp/support frame and painting with two or more coats of synthetic enamel paint of required shade complete as required :
4.4.1	80 mm dia.
4.5	Supplying and fixing single headed internal hydrant valve with instantaneous Gunmetal/Stainless Steel coupling of 63 mm dia with cast iron wheel ISI marked conforming to IS 5290 (Type -A) with blank Gunmetal/Stainless Steel cap and chain as required :
4.5.1	Single headed Stainless steel
4.6	Supplying, fixing, testing and commissioning of butterfly valve of PN 1.6 rating with bronze/gunmetal seat duly ISI marked complete with nuts, bolts, washers, gaskets conforming to IS 13095 of following sizes as required :
4.6.1	80 mm dia
4.6.2	100 mm dia
4.6.3	150 mm dia
4.7	Providing, installation, testing and commissioning of non-return valve of following sizes confirming to IS:5312 complete with rubber gasket, GI bolts, nuts, washers etc.as required :
4.7.1	100 mm dia
4.7.2	150 mm dia

4.8	Providing, installation, testing and commissioning of stainless steel Y-strainer fabricated out of 1.6 mm thick stainless steel, Grade 304, sheet with 3 mm dia holes with stainless steel flange.
4.8.1	150 mm dia
4.9	Supplying and fixing 63 mm dia, 15 m long RRL hose pipe with 63 mm dia male and female couplings duly bound with GI wire, rivets etc. conforming to IS 636 (type-A) as required :
4.9.1	Stainless Steel (Grade 304)
4.10	Supplying and fixing first-aid Hose Reel with MS construction spray painted in post office red, conforming to IS 884 complete with the following as required.
	20 mm nominal internal dia water hose thermoplastic (Textile reinforced) type -2 as per IS: 12585
	20 mm nominal internal dia gun metal globe valve & nozzle.
	Drum and brackets for fixing the equipment's on wall.
	Connections from riser with 25 mm dia stop gun metal valve & M.S. Pipe and socket.
4.10.1	40 m
4.11	Supplying & fixing 63 mm dia gun metal short branch pipe with 20 mm nominal internal diameter size nozzle conforming to IS 903 suitable for instantaneous connection to interconnect hose pipe coupling as required :
4.11.1	Stainless Steel (Grade 304)
4.12	Supplying and fixing of fire brigade connection of cast iron body with gun metal male instantaneous inlet couplings complete with cap and chain as reqd. for suitable dia MS pipe connection conforming to IS 904 as required :
4.12.1	2 way - 100 mm dia M.S. Pipe
4.13	Supplying and fixing air vessel made of 250 mm dia, 8 mm thick MS sheet, 1200 mm in height with air release valve on top and flanged connection to riser, drain arrangement with 25 mm dia gun metal wheel valve with required accessories, pressure gauge and painting with synthetic enamel paint of approved shade as required.
4.14	Providing & fixing of pressure switch in M.S. pipe line including connection etc. as required.
4.15	Providing and fixing MS partly glazed single/double hung lockable shutter fabricated from MS section as required with 5 mm thick glass for fire station complete including stove enamelled painting of door and frame and words "Fire Hydrant" written on glass, suitable to accommodate 2 Hydrant landing valves, 1 fire hose reel, 2 nos.15m long 63 mm dia hose,1-branch pipe, 1no. fire man's axe, fire extinguishers 2 nos, including suitably mounted on a raised masonry platform as required. (Approx. Size 0.90 m x 2.1m)
4.16	Providing and fixing dial type pressure gauge with isolation cock and pipe at hydrant station. Dial diameter 100 mm calibration, 0-15 kg

4.17	Providing and fixing resilient rubber neoprene lined single arch vibration eliminators with unit control suitable for raw water upto 45°C temperature working pressure 25 kg and test pressure 37.5 kg/cm ² .
4.17.1	150 mm dia
4.18	Design, manufacture, supplying, fixing in position, testing and commissioning of the following front operated cubicle type, front access 2mm thick mild steel sheet, free standing, dust and vermin proof, switchboard with IP42 protection with hinged and lockable doors complete with interconnections, tinned copper crimping lugs, bonding to earth and painting, suitable for use at 415 volts, 3 phase 4 wire 50 Hz system and suitable for a fault level of 25 MVA symmetrical at 415 volts.
4.18.1	MCC for Fire Fighting Pumps at Terrace
	INCOMING:
	a) One 100 amp. TP +NL M.C.C.B. with rotary handle of breaking capacity 25 KA
	b) One-Volt Meter (0-500 V) with selector switch
	c) One Set indicating lamps
	BUS BARS OUTGOING
	a) 100 Amp TPN BUS BAR (Aluminium).
	b) One - 63 Amp.TP +NL M.C.C.B. with rotary handle of breaking capacity 35KA
	c) One Fully Automatic D.O.L Starter suitable for Jockey Pump Motor 15 KW with over load relay, timer push buttons and Auto/Manual selector switch
	d) One panel type Amp. meters one for each motor with ASS. CTS etc.
	e) One sets of On/Off - neon indicating lamp.
	i) All interconnecting power & control wires/cables suitable size within the panel and from panel to motors , pressure switches, level switches, cable Tray, pipes etc. including brass glands termination within fire pump house and earthing as per specifications.
4.19	Providing and fixing heavy duty PVC insulated, PVC armoured conductor cables 1100 V grade including necessary support clamps and connection lugs complete in all respects.
4.19.1	Power cable 3 core 16 sq. mm aluminium conductor armoured cable.
4.20	Providing and fixing carbon-di-oxide type fire extinguishers consisting of welded M.S. cylindrical body, squeeze lever discharge valve fitted with pressure indicating gauge internal discharge tube 30 cms long high pressure discharge hose, discharge nozzle, suspension bracket conforming to IS:15683 finished externally with red enamel paint and fixed to wall with brackets complete with internal charge.
4.20.1	Capacity 4.5 Kg.
4.21	Providing and fixing ABC Powder type fire extinguishers consisting of welded M.S. cylindrical body, squeeze lever discharge valve fitted with pressure indicating gauge internal discharge tube 30 cms long high pressure discharge hose, discharge nozzle, suspension bracket conforming to IS:15683 finished externally with red enamel paint and fixed to wall with brackets complete with internal charge.
4.21.1	Capacity 6.0 Kg.
4.22	Providing, fixing, testing & commissioning of 15mm dia quartzoid bulb type sprinklers of rating 68 degree centigrade with required accessories :

4.22.1	Pendent Sprinkler
4.22.2	Upright Sprinkler
4.23	Providing & fixing flow switch in following sizes M.S. pipe including connection etc as required.
4.23.1	150mm dia
4.24	Providing, fixing, testing & commissioning of installation control valve of cast iron body, brass/bronze working parts comprising of water motor alarm, bronze seat clapper, clapper arm and hydraulically driven mechanical gong bell to sound continuous alarm when the wet riser/sprinkler system activates, pressure gauges, emergency releases, strainer, pressure switch, cock valve complete with drain valve and bypass, test control box, ball valves, MS pipe of required size, flanges, orifice plate, gasket etc of following sizes as required :
4.24.1	150mm dia
4.25	Supplying, installation, testing & commissioning of sprinkler flexible pipe (UL Listed) of stainless steel complete with 15 NPT on reducer thread with maximum working pressure of 175 PSI test pressure of 875 PSI (Burst) with branch line (Inlet) 25mm NPT male thread to sprinkler head (Outlet) 15mm NPT female thread with reducer, nipple, 2 side brackets, center bracket, stock bar of following sizes complete as required.
4.25.1	700mm
4.25.2	1000mm
4.25.3	1200mm
4.26	Providing, installation, testing & commissioning of adjustable rosette plate for 15mm dia in white finish UL Listed or FM approved complete as required.
4.27	Supplying and fixing of following sizes of steel conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.
4.27.1	25 mm
4.28	Supplying and installing following size of perforated pre-painted M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.
4.28.1	150 mm width x 50mm depth x 1.6 mm thickness.
4.29	Providing and fixing Drain & testing valve with built in bye pass arrangement and connection to drain line.
5.0	External Water Supply System
5.1	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings This includes jointing of pipes & fittings with one step CPVC solvent cement, trenching, refilling & testing of joints complete as per direction of Engineer in Charge.
	External work

5.1.1	32 mm nominal dia .Pipes.
5.1.2	40 mm nominal dia .Pipes.
5.1.3	50 mm nominal dia .Pipes.
5.1.4	65 mm nominal dia .Pipes.
5.1.5	80 mm nominal dia .Pipes.
5.2	Constructing masonry Chamber 30x30x50 cm inside, in brick work in cement mortar 1:4 (1 cement :4 coarse sand) for stop cock, with 300 X 300 mm inside dimension FRP cover with frame fixed in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12mm thick, finished with a floating coat of neat cement complete as per standard design :
5.2.1	With common burnt clay F.P.S.(non modular) bricks of class designation 7.5
5.3	Constructing masonry Chamber 60x60x75 cm inside, in brick work in cement mortar 1:4 (1 cement : 4 coarse sand) for sluice valve, with 600 X 600 mm inside dimension FRP cover with frame fixed in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick, finished with a floating coat of neat cement complete as per standard design :
5.3.1	With common burnt clay F.P.S.(non modular) bricks of class designation 7.5
5.4	Constructing masonry Chamber 90x90x100 cm inside, in brick work in cement mortar 1:4 (1 cement : 4 coarse sand) for sluice valve, with 900 X 900 mm inside dimension FRP cover with frame fixed in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) , i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick, finished with a floating coat of neat cement complete as per standard design :
5.4.1	With common burnt clay F.P.S.(non modular) bricks of class designation 7.5
5.5	Providing and filling sand of grading zone V or coarser grade, all-round the G.I. pipes in external work :
5.5.1	32 mm diameter pipe
5.5.2	40 mm diameter pipe
5.5.3	50 mm diameter pipe
5.5.4	65 mm diameter pipe
5.5.5	80 mm diameter pipe
5.6	Providing and fixing enclosed type water meter (bulk type) conforming to IS : 2373 and tested by Municipal Board complete with bolts, nuts, rubber insertions etc. (The tail pieces if required will be paid separately) :
5.6.1	150 mm dia nominal bore
5.7	Providing and fixing C.I. dirt box strainer for bulk type water meter with nuts, bolts, rubber insertions etc. complete conforming to IS : 2373 :

5.7.1	150 mm dia nominal bore
5.8	Providing and laying D.I. specials of class K-12 suitable for push-on jointing as per IS : 9523 :
5.8.1	Up to 600 mm dia
5.9	Providing push-on-joints to Centrifugally (Spun) Cast Iron Pipes or Ductile Iron Pipes including testing of joints and the cost of rubber gasket :
5.9.1	100 mm dia. Pipe
5.9.2	150 mm dia. Pipe
5.10	Providing and laying S&S Centrifugally Cast (Spun) / Ductile Iron Pipes conforming to IS : 8329 :
5.10.1	100 mm dia Ductile Iron Class K-9 pipes
5.10.2	150 mm dia Ductile Iron Class K-9 pipes
5.11	Disinfecting C.I. water mains by flushing with water containing bleaching powder @ 0.5 gms per litre of water and cleaning the same with fresh water, operation to be repeated three times including getting the sample of water from the disinfected main tested in the municipal laboratory.
5.11.1	100 mm diameter C.I. pipe
5.11.2	150 mm diameter C.I. pipe
5.12	Providing and fixing forged brass ball valve of brass body with hard chrome plated steel ball inside PTFE (Teflon) seat & ring with chrome plated centre handle with female BSP threads complete in all respects.
5.12.1	32 mm nominal bore
5.12.2	40 mm nominal bore
5.12.3	50 mm nominal bore
5.13	Supplying, fixing, testing and commissioning of butterfly valve of PN 1.6 rating with bronze/gunmetal seat duly ISI marked complete with nuts, bolts, washers, gaskets conforming to IS 13095 of following sizes as required :
5.13.1	65 mm dia
5.13.2	80 mm dia
5.13.3	100 mm dia
5.13.4	150 mm dia
6.0	External Sewerage System

6.1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.
6.1.1	All kinds of soil
6.2	Excavating trenches of required width for pipes, cables etc. including excavation for sockets and dressing of sides, ramming of bottoms, depth upto 1.5m including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20cm in depth including consolidating each deposited layer by ramming, watering etc. and disposing of surplus excavated soil as directed, within a lead of 50m.
6.2.1	All kinds of soil
6.2.1.1	Pipes, cables etc. exceeding 80 mm dia but not exceeding 300 mm dia.
6.3	Extra for excavating trenches for pipes, cables etc. in all kinds of soil for depth exceeding 1.5m, but not exceeding 3m. (Rate is over corresponding basic item for depth upto 1.5 metre).
6.3.1	Pipes, cables etc, exceeding 80mm dia but not exceeding 300mm dia
6.4	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.
6.5	Extra for every additional lift of 1.5m or part thereof in:
6.5.1	All kinds of soil (Manhole)
6.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level :
6.6.1	1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size)
6.7	Providing and fixing square-mouth S.W. gully trap class SP-1 complete with C.I. grating brick masonry chamber with water tight C.I. cover with frame of 300 x300 mm size (inside) the weight of cover to be not less than 4.50 kg and frame to be not less than 2.70 kg as per standard design :
6.7.1	180x150 mm size P type
6.7.1.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5
6.8	Providing, laying and jointing HDPE Double Wall Coil (DWC) SN-8 Grade pipes confirming to IS: 16098 including all fittings wherever required e.g., tees, bends of any degree, couplings, adapters, plugs, unions etc. and jointing as manufacturer recommendation etc. including testing of joints etc. complete.
6.8.1	150 mm dia.

6.8.2	200 mm dia.
6.8.3	250 mm dia.
6.8.4	315 mm dia.
6.9	Constructing brick masonry manhole in cement mortar 1:4 (1 cement : 4 coarse sand) with R.C.C. top slab with 1:1.5:3 mix (1 cement : 1.5 coarse sand (zone- III) : 3 graded stone aggregate 20 mm nominal size), foundation concrete 1:4:8 mix (1 cement : 4 coarse sand (zone- III) : 8 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with floating coat of neat cement and making channels in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) finished with a floating coat of neat cement complete as per standard design :
6.9.1	Inside size 90x80 cm and 45 cm deep including SFRC cover with frame (heavy duty) 455x610 mm internal dimensions.
6.9.1.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5
6.10	Extra for depth for manholes :
6.10.1	Size 90x80 cm
6.10.1.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5
6.11	Constructing Pre Cast/ Cast-in-situ RCC circular manhole 0.91 m internal dia at bottom and 0.56m dia at top in foundation concrete as per Structural Details and making necessary channel in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement, all complete as per standard design :
6.11.1	0.91 m deep with S.F.R.C. cover and frame (heavy duty, HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182 kg., fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) including centering shuttering all complete. (Excavation, foot rests and 12 mm thick cement plaster at the external surface shall be paid for separately) :
6.11.1.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
6.12	Extra depth for circular type manhole 0.91m internal dia (at bottom) with beyond 0.91m to 1.67m.
6.12.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
6.13	Constructing Pre Cast/ Cast-in-situ RCC circular manhole 1.22m internal dia at bottom and 0.56m dia at top in foundation concrete as per Structural Details and making necessary channel in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement, all complete as per standard design :
6.13.1	1.68 m deep with SFRC Cover and frame (heavy duty HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182kg. fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) including centering, shuttering all complete. (Excavation, foot rests and 12 mm thick cement plaster at the external surface shall be paid for separately) :

6.13.1.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
6.14	Extra depth for circular type manhole 1.22m internal dia (at bottom) beyond 1.68 m to 2.29 m :
6.14.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
6.15	Constructing Pre Cast/ Cast-in-situ RCC circular manhole 1.52 m internal dia at bottom and 0.56m dia at top in foundation concrete as per Structural Details and making necessary channel in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement, all complete as per standard design :
6.15.1	2.30 m deep with SFRC Cover and frame (heavy duty HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182kg. fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) including centering, shuttering all complete. (Excavation, foot rests and 12 mm thick cement plaster at the external surface shall be paid for separately) :
6.15.1.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
6.16	Extra depth for circular type manhole 1.52m internal dia (at bottom) beyond 2.30m :
6.16.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
6.17	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS : 10910 on 12mm dia steel bar conforming to IS : 1786 having minimum cross section as 23 mmx25mm and over all minimum length 263 mm and width as 165mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufacture's permanent identification mark to be visible even after fixing, including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) complete as per design.
6.18	Supply of Grease separator ECO-JET-OD NS 04 with sludge trap capacity 400 Ltrs. according to DIN EN 1825, for free standing installation, of polyethylene, material LLD-PE, with grease storage capacity 200 liters, total wastewater capacity 830 liters, with direct suction, with connecting flange DN 65 PN 10 For local suction line R 2 1/2", with fire hose quick coupling B with 2 odour proof maintenance openings DN 350 inlet and outlet DN 100. With max dimensions:
6.18.1	770x2000x1680mm With Inspection Windows & Filling Device.(Make : ACO Part No. 3554.64.41 or Equivalent)
6.19	Providing & laying HDPE pipes conforming to IS: 4984 type PE-80 (10 kg/cm ²) including fittings wherever required e.g., tees, bends of any degree, couplings, adapters, plugs, unions etc. and jointing as manufacturer recommendation etc. complete.
6.19.1	160 mm OD
7.0	Storm Water Drainage

7.1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.
7.1.1	All kinds of soil
7.2	Excavating trenches of required width for pipes, cables etc. including excavation for sockets and dressing of sides, ramming of bottoms, depth upto 1.5m including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20cm in depth including consolidating each deposited layer by ramming, watering etc. and disposing of surplus excavated soil as directed, within a lead of 50m.
7.2.1	All kinds of soil
7.2.1	Pipes, cables etc. exceeding 80mm dia but not exceeding 300mm dia.
7.2.2	Pipes, cables etc, exceeding 300 mm dia but not exceeding 600 mm dia
7.3	Extra for excavating trenches for pipes, cables etc. in all kinds of soil for depth exceeding 1.5m, but not exceeding 3m. (Rate is over corresponding basic item for depth upto 1.5 metre).
7.3.1	Pipes, cables etc, exceeding 80mm dia but not exceeding 300mm dia
7.3.2	Pipes, cables etc, exceeding 300 mm dia but not exceeding 600 mm dia
7.4	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.
7.5	Extra for every additional lift of 1.5m or part thereof in:
7.5.1	All kinds of soil (Manhole)
7.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level :
7.6.1	1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size)
7.7	Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40mm nominal size) up to haunches of S.W/RCC pipes including bed concrete as per standard design.
7.7.1	250 mm diameter
7.7.2	300 mm diameter
7.8	Providing and laying non-pressure NP2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete :
7.8.1	250 mm dia. R.C.C. pipe
7.8.2	300 mm dia. R.C.C. pipe

7.8.3	450 mm dia. R.C.C. pipe
7.8.4	500 mm dia. R.C.C. pipe
7.8.5	600 mm dia. R.C.C. pipe
7.8.6	900 mm dia. R.C.C. pipe
7.8.7	1000 mm dia. R.C.C. pipe
7.8.8	1100 mm dia. R.C.C. pipe
7.9	Constructing brick masonry manhole in cement mortar 1:4 (1 cement : 4 coarse sand) with R.C.C. top slab with 1:1.5:3 mix (1 cement : 1.5 coarse sand (zone- III) : 3 graded stone aggregate 20 mm nominal size), foundation concrete 1:4:8 mix (1 cement : 4 coarse sand (zone- III) : 8 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with floating coat of neat cement complete as per standard design :
7.9.1	Inside size 90x80 cm and 45 cm deep including SFRC cover with frame (heavy duty) 455x610 mm internal dimensions.
7.9.1.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5
7.10	Extra for depth for manholes :
7.10.1	Size 90x80 cm
7.10.1.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5
7.11	Constructing Pre Cast/ Cast-in-situ RCC circular manhole 0.91 m internal dia at bottom and 0.56m dia at top in foundation concrete as per Structural Details all complete as per standard design :
7.11.1	0.91 m deep with S.F.R.C. cover and frame (heavy duty, HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182 kg., fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) including centering shuttering all complete. (Excavation, foot rests and 12 mm thick cement plaster at the external surface shall be paid for separately) :
7.11.1.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
7.12	Extra depth for circular type manhole 0.91m internal dia (at bottom) with beyond 0.91m to 1.67m.
7.12.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
7.13	Constructing Pre Cast/ Cast-in-situ RCC circular manhole 1.22 m internal dia at bottom and 0.56m dia at top in foundation concrete as per Structural Details all complete as per standard design :

7.13.1	1.68 m deep with SFRC Cover and frame (heavy duty HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182kg. fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) including centering, shuttering all complete. (Excavation, foot rests and 12 mm thick cement plaster at the external surface shall be paid for separately) :
7.13.1.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
7.14	Extra depth for circular type manhole 1.22m internal dia (at bottom) beyond 1.68 m to 2.29 m :
7.14.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
7.15	Constructing Pre Cast/ Cast-in-situ RCC circular manhole 1.52 m internal dia at bottom and 0.56m dia at top in foundation concrete as per Structural Details all complete as per standard design :
7.15.1	2.30 m deep with SFRC Cover and frame (heavy duty HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182kg. fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) including centering, shuttering all complete. (Excavation, foot rests and 12 mm thick cement plaster at the external surface shall be paid for separately) :
7.15.1.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
7.16	Extra depth for circular type manhole 1.52m internal dia (at bottom) beyond 2.30m :
7.16.1	With Pre Cast/ Cast-in-situ RCC as per Structural Details.
7.17	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS : 10910 on 12mm dia steel bar conforming to IS : 1786 having minimum cross section as 23 mmx25mm and over all minimum length 263 mm and width as 165mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufacture's permanent identification mark to be visible even after fixing, including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) complete as per design.
7.18	Constructing bricks masonry road gully chamber 50x45x60 cm with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) including 500x450 mm pre-cast R.C.C. horizontal grating with frame complete as per standard design :
7.18.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5
7.19	Extra for depth beyond 45 cm of brick masonry chamber
7.19.1	For 455x610 mm size
7.19.1.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5

7.20	Providing and laying Non Pressure NP-3 class (Medium duty) R.C.C. pipes including collars/spigot jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete
7.20.1	450 mm dia RCC pipes.
7.20.2	600 mm dia RCC pipes.
7.20.3	900 mm dia RCC pipes.
8.0	Tube wells
8.1	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level :
8.1.1	1:2:4 (1cement : 2 Coarse sand : 4 graded stone aggregate 20 mm nominal size)
8.2	Boring/drilling bore well of required dia for casing/ strainer pipe, by suitable method prescribed in IS: 2800 (part I), including collecting samples from different strata, preparing and submitting strata chart/bore log, including hire & running charges of all equipment's, tools, plants & machineries required for the job, all complete as per direction of Engineer – in-charge, upto 90 metre depth below ground level.
8.2.1	All types of soil
8.2.1.1	400 mm dia
8.3	Boring/drilling bore well of required dia for casing/ strainer pipe, by suitable method prescribed in IS: 2800 (part I), including collecting samples from different strata, preparing and submitting strata chart/bore log, including hire & running charges of all equipment's, tools, plants & machineries required for the job, all complete as per direction of Engineer – in-charge, beyond 90 metre & upto 150 metre depth below ground level.
8.3.1	All types of soil
8.3.1.1	400 mm dia
8.4	Gravel packing in tube well construction in accordance with IS: 4097, including providing gravel fine/ medium/ coarse, in required grading & sizes as per actual requirement, all complete as per direction of Engineer-in-charge.
8.5	Supplying, assembling, lowering and fixing in vertical position in bore well, ERW (Electric Resistance Welded) FE 410 mild steel screwed and socketed/plain ended casing pipes of required dia, conforming to IS: 4270, of reputed & approved make, including painted with outside surface with two coats of anticorrosive paint of approved brand and manufacture, including required hire & labour charges, fittings & accessories, all complete, for all depths, as per direction of Engineer-in-charge.
8.5.1	200 mm nominal size dia having minimum wall thickness 5.40 mm
8.6	Supplying, assembling, lowering and fixing in vertical position in bore well, ERW (Electric Resistance Welded) FE 410 plain slotted (having slot of size 1.6/3.2 mm) mild steel threaded and socketed/ plain bevel ended pipe (type A) of required dia, conforming to IS: 8110, of reputed and approved make, having wall thickness not less than 5.40 mm, including painted with outside surface with two coats of anticorrosive bitumestic paint of approved brand and manufacture, including hire & labour charges, fittings & accessories,

	all complete, for all depths, as per direction of Engineer -in-charge.
8.6.1	200 mm nominal size dia
8.7	Development of tube well in accordance with IS : 2800 (part I) and IS: 11189, to establish maximum rate of usable water yield without sand content (beyond permissible limit), with required capacity air compressor, running the compressor for required time till well is fully developed, measuring yield of well by "V" notch method or any other approved method, measuring static level & draw down etc. by step draw down method, collecting water samples & getting tested in approved laboratory, i/c disinfection of tube well, all complete, including hire & labour charges of air compressor, tools & accessories etc., all as per requirement and direction of Engineer-in-charge.
8.8	Providing and fixing suitable size threaded mild steel cap or spot welded plate to the top of bore well housing/ casing pipe, removable as per requirement, all complete for borewell of:
8.8.1	200 mm dia
8.9	Providing and fixing M.S. clamp of required dia to the top of casing/ housing pipe of tube well as per IS: 2800 (part I), including necessary bolts & nuts of required size complete.
8.9.1	200 mm clamp.
8.10	Providing and fixing Bail plug/ Bottom plug of required dia to the bottom of pipe assembly of tube well as per IS:2800 (part I).
8.10.1	200 mm dia
8.11	Providing, laying, testing & commissioning of 'B' class heavy duty G.I. pipe conforming to IS 1239 including welding, fittings like elbows, tees, flanges, tapers, nuts, bolts, gaskets etc. and fixing the pipe on the wall/ceiling with suitable clamp/support frame and painting with two or more coats of synthetic enamel paint of required shade complete as required :
8.11.1	80 mm dia.
8.12	Supplying, fixing, testing and commissioning of butterfly valve of PN 1.6 rating with bronze/gunmetal seat duly ISI marked complete with nuts, bolts, washers, gaskets conforming to IS 13095 of following sizes as required :
8.12.1	80 mm dia
8.13	Providing, installation, testing and commissioning of non-return valve of following sizes confirming to IS:5312 complete with rubber gasket, GI bolts, nuts,washers etc.as required :
8.13.1	80 mm dia

8.14	Supply, Lowering, installation & testing of KSB make submersible pumping set with 7.5 HP to 10 HP motor 4 stage pump suitable for 15-20 m ³ hr. at 60 to 100 mtr. Head respectively. With Three Phase.
8.15	Providing & fixing Panel Board for submersible pump fitted with DOL starter ammeter, voltmeter single phase preventer standard/indo/cop make MCB of off switch push bottom duly wired and made out of 16/18 SWG sheet.
8.16	Providing & fixing submersible aluminium cable 6 sq.mm. from submersible pump to panel board.
9.0	Water Supply, Drainage Pumps & Water Treatment Equipment's
9.1	Supply, installation, testing & commissioning of vertical inline multistage pumping set (Imported) with Stainless steel body, impeller, casing, shaft and C.I. base & head with mechanical seal, connected to a TEFC induction motor suitable for 415+/- 10% volts, 3 phase 50 cycles A.C. supply with 150 mm dia pressure gauge with gunmetal isolation cock, vibration eliminating pads under foundations, 80x40 mm I section base plate bolted to cement concrete foundations complete. Vendor to submit performance curves and technical catalogue of the proposed model for review and information.
9.1.1	Filter Feed Pump (Dom. Water) at Water Supply Pump Room Set of Three Pumps (2 Working+ 1 Standby)
	Capacity 3.75 LPS
	Head 30 M.
	HP 2.5 HP Approx.
9.1.2	Softener Feed Pump (Cooling Tower) at Water Supply Pump Room Set of Two Pumps (1 Working+ 1 Standby)
	Capacity 6.5 LPS
	Head 30 M.
	HP 5.0 HP Approx.
9.1.3	Soft Water Transfer Pump (Cooling Tower) at Water Supply Pump Room Set of Two Pumps (1 Working+ 1 Standby)
	Capacity 6.5 LPS
	Head 60 M.
	HP 10.0 HP Approx.
9.1.4	Raw Water Transfer Pump to STP at Water Supply Pump Room Set of Two Pumps (1 Working+ 1 Standby)
	Capacity 4.5 LPS
	Head 25 M.
	HP 2.5 HP Approx.

9.2	<p>Providing, installing, testing and commissioning of variable speed (VSPS) Hydropneumatic system mounted on a common base plate comprising of vertical centrifugal pumping set with S.S body, stainless steel impeller and mechanical seal, shaft directly coupled to a TEFC induction motor suitable for 400/440 volts, 3 phase, 50 cycles AC supply with 150 mm dia pressure gauge with gunmetal isolation cock, vibration eliminating pads under foundation, one No. microprocessor based controller, dedicated variable frequency drive for each pump, one No. remote sensors, pressure transducers, sequence running controller, dry running Protection, motor control centre, necessary power and control cabling from MCC to pumps including required rating of MCB, one No. 60 litre capacity M.S diaphragm tank with interchangeable butyl rubber membrane, complete in all respects,</p>
	<p>including GI Heavy Class pipe suction and delivery headers and isolation/ control valves(ball valves/butterfly valves/ Nan return valves/ vibration eliminators etc as required) , power box, equipped with fuses/ isolators/circuit breakers as required.</p>
	<p>The entire Hydropneumatic system shall be factory fitted.</p>
9.2.1	<p>Hyd. System for Domestic Water Supply at Pump Room Set of Three Pumps (2 Working+ 1 Standby)</p>
	<p>Capacity 5.5 LPS</p>
	<p>Head 60 M.</p>
	<p>HP 7.5 HP Approx.</p>
9.2.2	<p>Hyd. System for Irrigation Water Supply at STP Pump Room Set of Two Pumps (1 Working+ 1 Standby)</p>
	<p>Capacity 5.0 LPS</p>
	<p>Head 50 M.</p>
	<p>HP 7.5 HP Approx.</p>
9.2.3	<p>Hyd. System for Flushing Water Supply at STP Pump Room Set of Two Pumps (1 Working+ 1 Standby)</p>
	<p>Capacity 5.5 LPS</p>
	<p>Head 60 M.</p>
	<p>HP 7.5 HP Approx.</p>
9.2	<p>Supply, installing, testing and commissioning of submersible open impeller non-clog pumps with C.I.body and to TEFC submersible motor for 415 ± 10% volts, 3 phase, 50 cycles A.C. power supply with mechanical seal, pump connector unit with rubber diaphragm and bend, vertical discharge pipe, guide pipe and chain in built level controller, sequence running controller, arrangement for both pumps together in case of emenegency, audible hooter for failure or flooding, dry running Protection complete in all respects., painting, testing and commissioning complete with approved quality and make as required as per instruction of site in charge.</p>
	<p>(Pumps shall be installed in a set of two pumps One working and One standby)</p>
9.3.1	<p>For Rain Water Transfer Pumps</p>
	<p>(Pumps to be suitable to handle solids upto 30 mm size)</p>
	<p>Capacity - 4.0 LPS (Each)</p>
	<p>Head - 30 M</p>
	<p>H.P. - 3.0 HP Approx.</p>

9.4	Supply Installation, Testing & Commissioning of vertical self-supporting Filter fabricated from MS sheet as per IS: 2825, ((minimum thickness of shall 6 mm and dished end 8 mm)) pressure gauges, sample cock, GI class 'C' face piping, CI butterfly valves and all accessories , with initial charge of filter media including anthracite, painting inside with epoxy paint and outside with two coat of red oxide primer and two or more coat of synthetic enamel paint, testing and commissioning complete.
9.4.1	Dual Media Filter For Domestic Water Supply
	Capacity- 13500 LPH
	Filtration rate- 14000 LPH/Sqm.
	Filter dia approx. - 1200 MM
	Working pressure: 3.0 Kg/sq. cm.
	Test pressure : 4. 5 Kg/sq. cm
9.4.2	Pressure Sand Filter For Rain Water
	Capacity- 13500 LPH
	Filtration rate- 14000 LPH/Sqm.
	Filter dia approx. - 1200 MM
	Working pressure: 3.0 Kg/sq. cm.
	Test pressure : 4. 5 Kg/sq. cm
9.5	Supply Installation, Testing & Commissioning of "Cation" ion exchange Water Softener fabricated from MS plate as per IS: 2825 (minimum thickness of shall 6 mm and dished end 8 mm) complete with initial charge of resins , GI class 'C' face piping, CI butterfly valves, pressure gauge, hydraulic brine injector, accessories, painting inside with epoxy paint, including 500 liters capacity PVC / HDPE brine tank suitable for 2 regeneration capacity, testing and commissioning complete with resins of approved quality and make.
9.5.1	For Cooling Tower Water Supply
	Hardness-
	Inlet- 500-600 PPM
	Outlet- Less than 5 PPM
	Capacity- 23400 LPH
	Regeneration period 12 hrs.
	Quantity of soft water
	between two regenerations = 280800 lit
	Working pressure: 3.0 Kg/sq. cm.
	Test pressure : 4. 5 Kg/sq. cm
9.6	Supply Installation, Testing & Commissioning of metering pump type chemical doser with 100 lits. HDPE chemical grade solution tank, injection fitting assembly, suction and delivery hose upto the point of injection, capacity 0-6 lph, complete in all respects.
9.6.1	Chlorination of Domestic Water
9.7	Design, manufacture, supplying, fixing in position, testing and commissioning of the following front operated cubicle type, front access 2mm thick mild steel sheet, free standing, dust and vermin proof, switchboard with IP42 protection with hinged and lockable doors complete with interconnections, tinned copper crimping lugs, bonding to earth and painting, suitable for use at 415 volts, 3 phase 4 wire 50 Hz system and suitable for a fault level of 25 MVA symmetrical at 415 volts.

	All switchboards shall have provision for entry of cables from the top or bottom as required.
	All live accessible parts shall be shrouded and all equipment shall be finger touch proof. The busbars insulation shall be with heat shrinkable sleeves. SMC/DMC shrouds and busbar supports shall be used. Padlocking facility shall be provided on all outgoing feeders doors and switch handles shall be lockable in OFF position.
9.7.1	Electric Panel For Water Supply Pumps at Water Supply Pump Room
	INCOMING
	1 No. 200 amps TPN MCCB with the following accessories:
	1 No. square flush mounting 0-500 volts scaled voltmeter with three way and OFF switch.
	Three phase indicating lights.
	Electrolytic high conductivity three phase and neutral tinned copper bus bar rated at 300 amps having a current density of 1 amp per Sqmm suitable to with stand symmetrical fault level of 25 MVA at 415 volts. The neutral bus bar is to be of 100% capacity.
	OUTGOING UNITS
	Two 25 Amp. TP + NL M.C.C.B. with rotary handle of breaking capacity 25KA
	Five 40 Amp. TP + NL M.C.C.B. with rotary handle of breaking capacity 25KA
	Four 63 Amp. TP + NL M.C.C.B. with rotary handle of breaking capacity 25KA
	03 Nos. TPN MCCB of 63 A with 25 KA service breaking capacity for Domestic water Hydropneumatic pumps. (Only connection to inbuilt panel of Domestic water Hydropneumatic system)
	02 Nos. TPN MCCB of 63 A with 25 KA service breaking capacity for Flushing water Hydropneumatic pumps. (Only connection to inbuilt panel of Domestic water Hydropneumatic system)
	02 Nos. TPN MCCB of 100 A with 25 KA service breaking capacity for Flushing water Hydropneumatic pumps. (Only connection to inbuilt panel of Domestic water Hydropneumatic system)
	11 Nos. fully automatic DOL starters with push buttons and ON/OFF indicating lights and overload relays for 1.5 to 25 HP pump .
	11 Nos. rotary selector switch for selecting mode of operation i.e. auto/manual/off.
	11 Nos.cyclic relay for automatic duty changeover of pumps.
	11 No. single phase preventors.
	11 Nos. square flush mounting 0-30 amps scaled ammeters with three way and OFF selector switch.
	Space for 4 Nos. Level Controllers.
	Switchgear shall be suitable for the HP ^S of various motors.
	4 Nos. 32 Amp. TPN MCB Spare.
	The motor control panel shall be prewired with colour coded wires with identification labels complete in all respects as required.
9.8	Supplying, installing, testing and commissioning controllers with low voltage relays, stainless steel probes and PVC shroud wiring from tank top to problems of required.
9.8.1	For Water Supply Pump:
	To start pump when water level is low in Domestic Water U.G. tank and shut off pump when Domestic Water U.G. tank is full. Also to stop when water level is low in raw water underground tank.

9.8.2	For Sump Pumps:
	To start pump when water level is high in sump and shut off pump when sump is empty. Both pumps are start when sump is over flowing.
9.9	Providing and fixing uPVC Schedule-80 Pipes & Fittings as per ASTM D 1785, ASTM D 2466-67 and clamps including MS pipe supports, enamel paint as per specifications cutting and making good the walls etc. complete.
9.9.1	50 mm dia
9.9.2	65 mm dia
9.9.3	80 mm dia
9.9.4	100 mm dia
9.9.5	150 mm dia
9.10	Supplying, fixing, testing and commissioning of butterfly valve of PN 1.6 rating with bronze/gunmetal seat duly ISI marked complete with nuts, bolts, washers, gaskets conforming to IS 13095 of following sizes as required :
9.10.1	50 mm dia
9.10.2	65 mm dia
9.10.3	80 mm dia
9.10.4	100 mm dia
9.10.5	150 mm dia
9.11	Providing, installation, testing and commissioning of non-return valve of following sizes confirming to IS:5312 complete with rubber gasket, GI bolts, nuts, washers etc.as required :
9.11.1	50 mm dia
9.11.2	65 mm dia
9.12	Providing and fixing resilient rubber neoprene lined style arch vibration eliminators suitable for raw water upto 45 deg.C. Temperature working pressure upto 25 Kg/Sqcm.
9.12.1	50 mm dia
9.12.2	65 mm dia
9.12.3	80 mm dia
9.13	Providing and fixing heavy duty armoured cables 1.1 KVA grade including necessary support clamps at ceiling level and connection lugs complete in all respects.
9.13.1	Power cable Copper 3 core 10 sq.mm
9.13.2	Power cable Copper 3 core 6 sq.mm
9.13.3	Power cable Copper 3 core 4 sq.mm
9.13.4	Control cable copper 2 core 1.5 sq.mm
9.14	Providing, installation, testing and commissioning of stainless steel Y-strainer fabricated out of 1.6 mm thick stainless steel, Grade 304, sheet with 3 mm dia holes with stainless steel flange.

9.14.1	100 mm dia.
9.14.2	150 mm dia.
10.0	Sewage Treatment Plant (MBR Technology)
	Design, Supplying, installing, testing & commissioning of fully automatic Sewage Treatment Plant of 415 KLD & 60 KLD Effluent Treatment Plant for the following duty:
	Nature of effluent - Domestic Sewage from toilet, kitchen waste water, domestic Laundry waste (if any) shall be discharged into the STP. Design to take consideration of same.
	INLET EFFLUENT CHARACTERSTICS
	pH - 6.5 – 8.5
	BOD - 500 Mg/L
	S. Solids - 250 Mg/L
	COD - 750 Mg/L
	Oil & Grease - 50 Mg / L (after oil and grease trap)
	DISCHARGE EFFLUENT CHARACTERSTICS AFTER TREATMENT
	pH - 6.0 – 8.0
	BOD - Less than 5 Mg/L
	S. Solids - Less than 50 Mg/L
	COD - Less than 20 Mg/L
	Oil & Grease - below detectable level
	Turbidity - Less than 1 NTU
	E coli Removal - below detectable level
10.1	ETP Cap 60 KLD Electrical & Mechanical Works
	Supply, installation, testing & commissioning of 1 No Stainless Steel Perforated Screen with suitable lifting arrangement (size 500 mm wide x 400 mm high approx.). It should be feasible to take out the screens from the chamber for periodical cleaning. Set-1
	Supply and fixing of mechanical belt type oil skimmer basin MS housing with 500 litre HDPE tank for 1/2 Lph flow rate capacity complete in all respect. Set-1
	Supply, installation, testing & commissioning of non-clogging type pumps, having CI casing CI impeller & SS Shaft complete with all accessories, motor of required capacity. Delivery header with isolation valve, pressure gauge on delivery line with isolation cock level controller with wiring to control the level of sump automatically. Pump shall have following duty.
	Effluent Transfer pump (2 Nos - 1 working + 1 Standby) Set-1
	Flow rate (each) = 6 M3/hr
	Head = 10 Mtr
	Supply, installation, testing and commissioning of mixer in reaction tank cum flocculation tank for mixing of chemical. The mixer shall be of slow speed of around 70-100 RPM with 1 mtr long shaft in SS 304. Set-1

	Online pH meter with dosing system of capacity 0-12 LPH along with necessary frame. Dosing tank and other equipment's to make it complete. Set-1
	Supplying, installing, testing and commissioning of lime (CaO) dosing system consisting of one HDPE tank of 100 liters capacity with metering pump of 0-12 lph with necessary polypropylene piping & valve . Set-1
	Supplying, installing, testing and commissioning of Alum dosing system consisting of one HDPE tank of 100 liters capacity with metering pump of 0-12 lph,with necessary polypropylene piping & valves. Set-1
	Supplying, installing, testing and commissioning of Polyelectrolyte dosing system consisting of one HDPE tank of 20 liters capacity with metering pump of 0-12 lph with necessary polypropylene piping & valves. Set-1
	Supplying, installing, testing and commissioning of Chlorine dosing system consisting of one HDPE tank of 100 liters capacity with metering pump of 0-12 lph with necessary polypropylene piping & valves. Set-1
	Supply, installation, testing and commissioning of Tube Deck Media in settling tank. Lot-1
	Supply, installation, testing and commissioning of self-supported Electric Control Panel fabricated from 14 g sheet, powder coated, all necessary switchgears suitable for above equipment's. Set-1
	ETP as Describe above
10.2	STP Cap 415 KLD Electrical & Mechanical Works
	-
	Design, supplying, installing, testing & commissioning of 415 KLD Sewage Treatment Plant for Domestic Waste/Kitchen (excluding all Civil & construction work) for the following duty:-
	Supply, installation, testing & commissioning of 2 Nos. Stainless Steel-316 Perforated Corrugated Screen of size 1000mm x 1000mm fabricated through 5mm thick plate having holes of 8 mm at a distance of 10 mm with suitable lifting arrangement. This is to slide in the fixed ss channels fixed on the side walls. Set-1
	Supply and installation of MS Class 'C' with hot dip galvanized puddle flange 25 mm to 200 mm dia. in accordance to relevant IS pipe standards as required to be provided (in the structural slab & wall) of various diameter. Puddle flanges shall be provided for all the structural component of the STP/ETP. Lot-1
	Supply and fixing of mechanical punched hole fine screen for 2-3 mm size complete as required MOC- SS 304. Set-1
	Supply and fixing of mechanical belt type oil skimmer basin MS housing with 500 litre HDPE tank for 1/2 Lph flow rate capacity complete in all respect. Set-1

	Supply and fixing of electronic type level indicator and controller for automatic operation of the system with high/low level alarm complete with auxiliary NO/NC contacts for each tank. Lot-1
	Supply and fixing of sight tube (of 3.5 to 4.5 m length) with isolation valve at top/bottom, demarcation on tube & for making the installation complete. Lot1
	Supplying and fixing of fully submersible, centrifugal non-clog sewage handling type pump for raw sewage transfer from equalization tank to Anoxic Tanks. The pump shall have CI casing, CI impeller and SS shaft, TEFC induction motor suitable for 415+10% Volt, 3 Phase, 50 Cycles AC Power supply, Mechanical seal, Pump connector unit with rubber diaphragm and bend including pressure gauge, lifting arrangement/lifting device of pull chain/guide rail for the pump, sequence running controller, dry running protection, level controller complete with probes complete in all respect including delivery header & delivery pipe (interconnecting piping) with GI 'C' class pipe of required dia, isolation valves, NRV & vibration eliminators on delivery side of Pumps.
	Equalisation Transfer Pump - Set-1
	Capacity/Flow rate - 21 m ³ /h
	Pumping Head - 8-10 Mtr
	Solid Handling: 40-50 mm
	Set of 2 Nos. Pumps (1 Working +1 Standby)
	Sewage Lifting Pump - Set-1
	Capacity/Flow rate - 30 m ³ /h
	Pumping Head - 12-15 Mtr
	Solid Handling: 40-50 mm
	Set of 2 Nos. Pumps (1 Working +1 Standby)
	Effluent Lifting Pump - Set-1
	Capacity/Flow rate - 5.4 m ³ /h
	Pumping Head - 12-15 Mtr
	Solid Handling: 40-50 mm
	Set of 2 Nos. Pumps (1 Working +1 Standby)
	Sewage Sump Pump - Set-1
	Capacity/Flow rate - 15 m ³ /h
	Pumping Head - 10-12 Mtr
	Solid Handling: 40-50 mm
	Set of 2 Nos. Pumps (1 Working +1 Standby)
	Air diffusion system shall include the following:
	Supply and fixing of 2 No. twin type rotary air blowers (2W + 1S) capable of delivering 350 cum/hr of free air at 0.5 kg/cm ² for Aeration Tank and Equalisation tank. driven through "V" belt or directly coupled through flexible coupling to a TEFC motor of suitable HP Suitable for 415 ± 10% volts, 3 phase, 50 cycles A/C supply. 1225 RPM with all accessories complete in all respects. Set-1
	Supply and fixing of 2 No. twin type rotary air blowers (1W + 1S) capable of delivering 350 cum/hr of free air at 0.5 kg/cm ² for TW membrane scouring system. driven through "V" belt or directly coupled through flexible coupling to a TEFC motor of suitable HP Suitable for 415 ± 10% volts, 3 phase, 50 cycles A/C supply. 1300 RPM with all accessories complete in all respects. Set-1

	Supply and fixing Disc type, EPDM membrane based, non-clog type air dispersion system capable of handling 3-5 cfm of air with oxygen transfer efficiency of 3-4% per/meter water depth. Air dispersion grid shall be assembled in modular form so that they can be replaced / repaired easily from plat form at the top. (Imported fine bubble membrane diffusers for equalisation tank, aeration tank & sludge holding tank) Lot-1
	Supply and fixing Tube type, silicon membrane based, non-clog type air dispersion system capable of handling 3-5 cfm of air with oxygen transfer efficiency of 3-4% per/meter water depth. Air dispersion grid shall be assembled in modular form so that they can be replaced / repaired easily from plat form at the top. (Imported fine bubble membrane diffusers for MBR tank) Lot-1
	Note : Air dispersion system shall be provided for Equalisation tank, Aeration tank, MBR tank and Sludge holding tank.
	Providing, Laying, testing & Commissioning of "C" Class Heavy duty MS Pipe 40 mm to 150 mm dia. conforming to IS:3589 & 1239 including fittings like elbows, tees, flanges, nut bolts, gaskets with suitable clamps & painting with Two or more coats of synthetic enamel paint of required shade over a coat of steel primer complete as required. For Interconnecting Lines and Air Lines. (Lot-1)
	Providing, Laying, testing & Commissioning of stainless steel grade-304 schedule-10 50 mm to 100 mm dia including fittings like elbows, tees, flanges, nut bolts, gaskets with suitable clamps. Lot-1
	Providing & fixing CI butterfly valve 50 to 150 mm dia tested to a pressure not less than 15 Kg/Sq.cm. Including rubber gasket, 2 nos. table-E flanges, nuts, bolts, washers & painting complete as required. Lot-1
	Providing & fixing dual plate CI wafer type check valve 50 mm to 150 mm dia. tested to a pressure of 10 Kg/sqcm. Including rubber gasket, 2 nos. table-E flanges, union, nuts, bolts, washers & painting complete as required. Lot-1
	Supply, installation, testing & commissioning of MBR modules of hollow fibre reinforced filtration membranes with SS – 316 skid for housing the membranes & air grid for scouring the sludge, permeate S.S piping etc. complete in all respect as required.
	Membrane Tank of RCC - Membrane Accessories, Valve, Instrument, Permeate Collection and air distribution header piping etc. Back pulse tank of FRP, Permeate cum backpluse pump with VFD : CI 1w+1s capacity : 60 m3/hr , Membrane blower without acoustic hood MOC : CI 1w +1S capacity : 500 Nm3/hr, Type : Twin lobe type, Chemical dosing system : 1W, * Membrane shall have max pore size of 0.04 micron. Membrane shall have 2 year full replacement cliff warranty. Set-1
	Supply and fixing of ultraviolet dis-infection unit of 25 cum/hr. capacity. The unit shall have over 99.9 % bacterial reduction from inlet to outlet. The dis-infection chamber shall be constructed of SS 316L on all welded parts. The UV lamp shall be of low pressure mercury vapour type with hard glass enclosure, the sockets shall be water tight & vibration resistant. The lamp life shall be rated for 6000 hours. The unit shall be complete with temperature safety control, lamp out alert circuit & UV radiometer with 4 – 20 mA output as of manufacturers recommendation in all respects.

	The UV unit shall have with reactor, cabinet housing, cabinet cooling, treatment chamber, electrical panel, temperature safety control, lamp out alert, UV radiometer along with UV monitoring system and UV monitoring readout panel. The UV Dosage should be > 60,000 uW – Sec / sq.cm. The lamps should be selected based upon the flow requirement of respective unit. as recommended by manufacturer complete in all respects. 1 No.
	Flow Rate :25 M3/hr
	Supply and fixing of horizontal, centrifugal Sludge disposal pump for the disposal of sludge from tube settler to sludge holding tank. The pumps shall have CI casing, CI/bronze Impeller & SS shaft & sleeve with mechanical rotary shaft seal connected by a flexible tier type coupling to TEFC induction motor suitable for 415+10% Volts, 3 Phase, 50Hz, AC Power Supply mounted on a common channel base-plate with coupling guard, 150 mm dia pressure gauge with GM isolation cock, suitable vibration eliminator pads under foundation of approved design, dry running protection including all necessary piping, valves, level controller complete with probs and other accessories complete as required.
	Sludge Recycling Pump (Set-1)
	Capacity/Flow rate - 40 M3/h
	Pumping Head - 8-10 Mtr
	(Solid handling size for this pump shall be 7-10 mm)
	Set of 2 Nos. Pumps (1 Working +1 Standby)
	Supply and fixing of basket/Screw/Solid bowl type centrifuge with top discharge of suitable for 3 batches in a day with interconnecting piping, lifting arrangement, pump and poly dosing system. The basket shall be in SS 304 construction complete in all respects. Set-1
	Supply and fixing of Cetrifuge Feed pump of suitable capacity with CI body, SS-Impeller and Shift complete(Screw Type) - 2 Nos. (1working+1standby) Set-1
	Supply and fixing of following instrument for the auto operation of System and safety of MBR modules.
	Electro-magnetic flow meter cum totalizer at the sewage inlet and outlet of membrane suction pump of suitable size. 2 Nos.
	pH Meter at membrane suction pump outlet for measurement of pH. 1 No.
	Differential pressure switch transmitter and for pressure alarm high and low, flow switch for flow alarm high and low. Set-1
	Online rotameter for checking the air flow to the MBR module. Set-1
	Air Rotameter for Biological Air supply and Air scouring. Set-1
	STP as Describe above
10.3	ELECTRICAL WORKS FOR STP

	Supply and fixing of the following front operated cubicle type compartmentation, front access totally enclosed sheet steel clad, free standing, dust and vermin proof, switchboards with IP 42 protection with hinged, gasketed and lockable doors including interconnections, copper crimping lugs, brass glands, bonding to earth and painting, suitable for use at 415 volts, 3 phase 4 wire 50 Hertz system, and with 25 kA rupturing capacity at 415 volts complete as per specifications, as required and as below.
	All switchboards shall have provision for entry of cables from the top or bottom as required.
	All live accessible parts shall be shrouded and all equipment shall be finger touch proof. The busbars insulation shall be with heat shrinkable sleeves. SMC/DMC shrouds and busbar supports shall be used. Padlocking facility shall be provided on all outgoing feeders doors and switch handles shall be lockable in OFF position.
	INCOMING
	1 No. 200 Amp 25 kA TPN MCCB with Thermal over load and magnetic short circuit release site settable
	INDICATING PANEL
	The incomers shall have the following indicating panel
	Square flush mounting 0-150 amp scaled ammeter with 3 way and OFF selector switch
	3 nos. Cast resin current transformers of 150/5 ratio Class 1.0, 15 VA burden for metering
	Three phase indicating lamps
	Square flush mounting voltmeter scaled 0-500 volt with 3 way and OFF selector switch
	BUSBAR
	Electrolytic high conductivity aluminium three phase and neutral busbars rated at 200 amps having a maximum current density of 1 amp per sq. mm suitable to with stand symmetrical fault level of 25 kA at 415 volts for 1 second. The neutral busbar is to be of 50% capacity.
	OUTGOING UNITS
	2 nos 25 KA Motor Protection circuit breaker with short circuit magnetic releases and thermal over load release with Type 2 Coordination for 12.5 KW Motors. (Air blower)
	Star-Delta starter contactor with adequate numbers of NO/NC for remote operation
	Single phase preventer - current operated
	CT operated square flush mounting ammeter with 3 way and OFF selector switch
	1 set of ON/OFF indication lamps
	Auto/ Manual selector switch
	ON/OFF Push Button
	2 nos 25 KA Motor Protection circuit breaker with short circuit magnetic releases and thermal over load release with Type 2 Coordination for 10 KW Motors. (Air blower)
	Star-Delta starter contactor with adequate numbers of NO/NC for remote operation
	Single phase preventer - current operated

	CT operated square flush mounting ammeter with 3 way and OFF selector switch
	1 set of ON/OFF indication lamps
	Auto/ Manual selector switch
	ON/OFF Push Button
	6 nos 25 KA Motor Protection circuit breaker with short circuit magnetic releases and thermal over load release with Type 2 Coordination for 3 KW Pumps. (Eq. transfer, MBR suction, sludge feed))
	DOL starter contactor with adequate numbers of NO/NC for remote operation
	Single phase preventer - current operated
	CT operated square flush mounting ammeter with 3 way and OFF selector switch
	1 set of ON/OFF indication lamps
	Auto/ Manual selector switch
	ON/OFF Push Button
	8 nos 25 KA Motor Protection circuit breaker with short circuit magnetic releases and thermal over load release with Type 2 Coordination for (4 Nos. 2 KW motor & 4 Nos. 1.5 KW Pumps). (Sump, MBR permeate, MBR backwash, softener feed))
	DOL starter contactor with adequate numbers of NO/NC for remote operation
	Single phase preventer - current operated
	CT operated square flush mounting ammeter with 3 way and OFF selector switch
	1 set of ON/OFF indication lamps
	Auto/ Manual selector switch
	ON/OFF Push Button
	2 nos 25 KA Motor Protection circuit breaker with short circuit magnetic releases and thermal over load release with Type 2 Coordination for 0.5 KW Pumps. (Hydro dosing solution pump, citric solution dosing pump)
	DOL starter contactor with adequate numbers of NO/NC for remote operation
	Single phase preventer - current operated
	CT operated square flush mounting ammeter with 3 way and OFF selector switch
	1 set of ON/OFF indication lamps
	Auto/ Manual selector switch
	ON/OFF Push Button
	1 no 100 amps 690 volt 25 kA TPN MCCB with thermal over load and magnetic short circuit release as spare
	2 nos 63 amps 690 volt 25 kA TPN MCCB with thermal over load and magnetic short circuit release as spare
	The Switchboard shall be complete with all interconnections, risers, internal wiring, labels etc complete as required. Electric Panel 1 No.
	Supplying & laying of following 1100 volt grade XLPE insulated PVC sheathed copper conductor armoured cables as per specification in existing trenches, cable trays, ducts, clamped to wall with suitable clamps including providing and fixing of all fixing accessories, connecting, testing and commissioning. Lot-1
	Electrical Works for STP as above

11.0	External Fire Fighting System
11.1	Supplying, installation, testing and commissioning of Electric driven Main Fire Pump suitable for automatic operation and consisting of following, complete in all respects, as required :
	Horizontal type, multistage, centrifugal, split casing pump of cast iron body & bronze impeller with stainless steel shaft, mechanical seal conforming to IS 1520.
	Suitable HP Squirrel cage induction motor, TEFC, synchronous speed 1500 RPM, suitable for operation on 415 volts, 3 phase 50 Hz, AC supply with IP 55 protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS-325.
	M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.
	Suitable cement concrete foundation duly plastered with anti-vibration pads.
11.1.1	2850 LPM at 88 m Head
11,2	Supplying, installation, testing and commissioning of diesel engine driven main fire pump suitable for automatic operation and consisting of following, complete in all respects, as required : (Diesel Driven Pump)
	Horizontal type, multistage, centrifugal, split casing pump of cast iron body & bronze impeller with stainless steel shaft, mechanical seal conforming to IS 1520.
	Suitable HP, 1500 RPM water cooled with radiator, diesel engine conforming to relevant IS standard complete with auto starting mechanism, 12 /24 volts electric starting equipment, diesel tank, exhaust pipe extended upto 10 m outside pump house duly insulated with 50 mm thick glass wool with 1.0 mm thick aluminium sheet cladding, residential silencer, instruments and protection as per standard specification, stop solenoid for auto stop in the event of fault with audio indications, painted with post office red colour etc. as required.
	M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.
	Suitable cement concrete foundation duly plastered with anti-vibration pads.
11.2.1	2850 LPM at 88 m Head
11.3	Supplying, installation, testing and commissioning of electric driven pressurisation pump suitable for automatic operation and consisting of following, complete in all respects, as required : (Jockey Pump)
	Horizontal type, multistage, centrifugal pump of cast iron body and bronze impeller with stainless steel shaft, mechanical seal conforming to IS : 1520.
	Suitable HP Squirrel cage induction motor, TEFC, synchronous speed 1500 RPM, suitable for operation on 415 volts, 3 phase 50 Hz, AC supply with IP 55 protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS-325.

	M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.
	Suitable cement concrete foundation duly plastered with anti-vibration pads.
11.3.1	180 LPM at 88 m Head
11.4	Fabrication, supply, Installation testing & commissioning of Electrical control panel of cubical construction, floor mounted type, fabricated out of 2mm thick CRCA sheet, compartmentalised with hinged lockable doors, dust and vermin proof, powder coated of approved shade after 7 tank treatment process, cable alley, interconnection with suitable size copper conductor cable/solid copper strip, having switchgears and accessories, mountings and internal wiring, earth terminals, numbering etc. complete in all respect, suitable for main fire pump, pressurisation pump & diesel pump set complete as per CPWD specification with following in coming and Outgoings, suitable for operation on 415V, 3 phase, 50Hz Ac Supply with enclosure protection class IP 42 as required :
11.4.1	Incomings
	800A, 50kA 4 Pole MCCB, Ics=100% Icu Rating Digital Voltmeter 0-500V with selector switch Ammeter (0-800 A) with selector switch & CTs etc. LED type RYB phase indicating lamps, ON, OFF, trip indicating lamps Set of Copper Bus Bar 800Amps
	Outgoings
	(Note : All outgoing feeders for pumps should have digital Ammeter with selector switches, and LED type ON, OFF, trip indicating lamps)
	Main Fire Pumps
	250 Amp, 50kA TPN MCCB, Ics=100% Icu, with fully automatic Star/Delta starter suitable for 100 to 125 hp pump with overload protection, current sensing type single phase preventor complete with all accessories and internal wiring required for automatic operation, selector switch for local/remote, to/manual/OFF operation. - 2 sets
	Jockey Pump
	125 Amp, 50kA TPN MCCB, Ics=100% Icu, with Suitable HP fully automatic Star/Delta starter with overload protection, current sensing type single phase preventor complete with all accessories and internal wiring required for automatic operation, selector switch for local/remote, auto/manual/OFF operation. - 2 sets
	Diesel Engine Control
	Control for diesel engine comprising - Automatic/Manual selector switch & 3 attempts starting device, timers and relays as required, push buttons, start/stop in manual mode Indicating lamp for high/ Low Lub. Oil pressure, High Water Temp and Engine on indication Battery charger suitable for 12V/24 V DC with boost and trickle selector switch, 0-30 V DC volt meter, and 0-20 A DC Ammeter
	All standard relays and accessories for automatic operation of diesel engine System Controller
	Designing, Supply, Installation, Testing and commissioning of system controller to control operation of main electric fire pump, diesel pump, Pressurization pump, Terrace pump in sequence as per specification consisting of relays, timers. Sensors, annunciation window for fault indication, complete as per specification

11.5	Providing laying, testing & commissioning of Ductile Iron class K-9 Pipe conforming to IS 8329 i/c Ductile Iron fittings class K-12 conforming to IS 9523 like elbows, tees, flanges, tapers, nuts bolts, gaskets etc. in ground including push-on-joints, excavation & providing cement concrete blocks as supports, refilling the trench etc. of following sizes complete as required.
11.5.1	150 mm. Dia
11.5.2	80 mm dia.
11.5.3	100 mm dia.
11.6	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like elbows, tees, flanges, tapers, nuts bolts, gaskets etc. and fixing the pipe on the wall/ceiling with suitable clamp/support frame and painting with two or more coats of synthetic enamel paint of required shade complete as required :
11.6.1	80 mm dia
11.6.2	100 mm dia
11.6.3	150 mm dia
11.6.4	250 mm dia (wall thickness 6.3 mm)
11.6.5	300 mm dia (wall thickness 7.1 mm)
11.7	Supplying and fixing Single headed external yard hydrant valve with 1 No. 63 mm dia instantaneous FM Gunmetal/Stainless Steel coupling and cast iron wheel, ISI marked, conforming to IS 5290 (type A) with blank Gunmetal/Stainless Steel cap and chain as required :
11.7.1	Single headed Stainless steel
11.8	Supplying, fixing, testing and commissioning of butterfly valve of PN 1.6 rating with bronze/gunmetal seat duly ISI marked complete with nuts, bolts, washers, gaskets conforming to IS 13095 of following sizes as required :
11.8.1	80 mm dia
11.8.2	100 mm dia
11.8.3	150 mm dia
11.8.4	200 mm dia
11.8.5	250 mm dia
11.9	Providing, installation, testing and commissioning of non-return valve of following sizes confirming to IS:5312 complete with rubber gasket, GI bolts, nuts,washers etc.as required :
11.9.1	80 mm dia
11.9.2	100 mm dia
11.9.3	150 mm dia
11.9.4	200 mm dia
11.9.5	250 mm dia
11.10	Providing, installation, testing and commissioning of stainless steel Y-strainer fabricated out of 1.6 mm thick stainless steel, Grade 304, sheet with 3 mm dia holes with stainless steel flange.

11.10.1	150 mm dia
11.11	Supplying and fixing 63 mm dia, 15 m long RRL hose pipe with 63 mm dia male and female couplings duly bound with GI wire, rivets etc. conforming to IS 636 (type-A) as required :
11.11.1	Stainless Steel (Grade 304)
11.12	Supplying & fixing 63 mm dia gun metal short branch pipe with 20 mm nominal internal diameter size nozzle conforming to IS 903 suitable for instantaneous connection to interconnect hose pipe coupling as required :
11.12.1	Stainless Steel (Grade 304)
11.13	Supplying and fixing of fire brigade connection of cast iron body with gun metal male instantaneous inlet couplings complete with cap and chain as reqd. for suitable dia MS pipe connection conforming to IS 904 as required :
11.13.1	4 way - 150 mm dia M.S. Pipe
11.14	Providing & fixing of pressure switch in M.S. pipe line including connection etc. as required.
11.15	Providing, fixing, testing & commissioning of installation control valve of cast iron body, brass/bronze working parts comprising of water motor alarm, bronze seat clapper, clapper arm and hydraulically driven mechanical gong bell to sound continuous alarm when the wet riser/sprinkler system activates, pressure gauges, emergency releases, strainer, pressure switch, cock valve complete with drain valve and bypass, test control box, ball valves, MS pipe of required size, flanges, orifice plate, gasket etc of following sizes as required :
11.15.1	150mm dia
11.16	Supplying and fixing of following sizes of steel conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.
11.16.1	25 mm
11.17	Supplying and installing following size of perforated pre-painted M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.
11.17.1	150 mm width x 50mm depth x 1.6 mm thickness.
11.18	Providing and fixing of Weather proof hose cabinets fabricated from 14 g M.S. Sheet with full glass door and mortise locking arrangement , suitable to accommodate one Hydrant landing valve, 2 nos. 15 M long hose and 1 No branch pipe. The cabinet shall be painted with one coat of primer and finished stove enamelled "Fire Red", "Fire Hose" written on front including suitably mounted on a raised masonry platform as required. (Approx 0.75mx0.6 m x 0.25 m).
11.19	Providing and fixing dial type pressure gauge with isolation cock and pipe at hydrant station. Dial diameter 100 mm calibration, 0-15 kg

11.20	Providing and fixing resilient rubber neoprene lined single arch vibration eliminators with unit control suitable for raw water upto 45°C temperature working pressure 25 kg and test pressure 37.5 kg/cm ² .
11.20.1	80 mm dia.
11.20.2	100 mm dia
11.20.3	150 mm dia
11.21	Providing and fixing heavy duty PVC insulated, PVC armoured conductor cables 1100 V grade including necessary support clamps and connection lugs complete in all respects.
11.21.1	Power cable 3.5 core 120 sq. mm aluminium conductor armoured cable
11.21.2	Power cable 3 core 16 sq. mm aluminium conductor armoured cable.
11.21.3	Control cable copper 2 core 1.5 sq.mm
11.22	Supply, Installation, Testing & Commissioning of double flanged vertical air vessel fabricated shell from 10 mm thick & dished ends 12 mm thick M.S.plate, suitable for working pressure of 18 kg/cm ² and test pressure of 27 kg/cm ² , 450 mm dia and 2.00 m high for fire pumps complete with four nos dual setting pressure switches to operate jockey and main pumps at drop of pressure as given in the specifications.
11.23	Providing & fixing 150 mm diameter MS Class 'C' for diesel engine exhaust pipe (including all fittings, clamps, steel support) of suitable dia for the diesel engine. The pipe shall be provided insulation with fibre glass wool and wrapped with 24g. aluminium sheet complete with all respect.
11.24	Providing and fixing of gun metal fire Brigade Suction Hose coupling (Draw-out Connection) with nut for female coupling as per IS:902- 1974 complete with 100 mm dia. G.I. Suction pipe and 100 mm dia. 1No. C.I. Foot valve flanged (to be connected to static water tank).
11.25	Providing and fixing carbon-di-oxide type fire extinguishers consisting of welded M.S. cylindrical body, squeeze lever discharge valve fitted with pressure indicating gauge internal discharge tube 30 cms long high pressure discharge hose, discharge nozzle, suspension bracket conforming to IS:15683 finished externally with red enamel paint and fixed to wall with brackets complete with internal charge.
11.25.1	Capacity 4.5 Kg.
11.26	Providing and fixing mechanical foam type fire extinguishers consisting of welded M.S. trolley mounted cylindrical body, squeeze lever discharge valve fitted with pressure discharge hose, discharge nozzle, trolley etc., ISI marked as per IS:IS:13386 finished externally with red enamel paint.
11.26.1	Capacity 50 lit (D.G.Room)
11.27	Providing and fixing carbon-di-oxide fire extinguishers trolley mounted with all accessories internal discharge tube, high pressure discharge hose, discharge nozzle, ISI marked as per IS:2878 finished externally with red enamel paint.
11.27.1	Capacity 22.5 kg.

11.28	Providing and fixing ABC Powder type fire extinguishers consisting of welded M.S. cylindrical body, squeeze lever discharge valve fitted with pressure indicating gauge internal discharge tube 30 cms long high pressure discharge hose, discharge nozzle, suspension bracket conforming to IS:15683 finished externally with red enamel paint and fixed to wall with brackets complete with internal charge.
11.28.1	Capacity 6.0 Kg.
12.0	Landscape Irrigation
12.1	Providing, laying and jointing HDPE pipes conforming to IS: 4984 PE-100, (10 Kg/Cm ²) including all fittings wherever required e.g., tees, bends of any degree, couplings, adapters, plugs, unions etc. and jointing as manufacturer recommendation etc. including testing of joints etc. complete.
12.1.1	40 mm OD HDPE Pipe
12.1.2	50 mm OD HDPE Pipe
12.1.3	63 mm OD HDPE Pipe
12.1.4	75 mm OD HDPE Pipe
12.1.5	110 mm OD HDPE Pipe
12.2	Providing & fixing of 3/4" Brass Quick Coupling Valve complete with all respects.
12.3	Providing & fixing of 3/4" Brass Quick Coupling Key complete with all respects.
12.4	Providing & fixing of 3/4" Brass Quick Swivel Hose Elbow complete with all respects.
12.5	Providing and fixing of PVC Ball Valve (DU) complete with all respects
12.5.1	75 mm
12.5.2	63 mm
12.5.3	50 mm
12.5.4	40 mm
12.6	Providing and fixing of Valve box 12" Rectangular Valve Box with cover.

Note : The schedule of items mentioned above are indicative and not exhaustive, Any item not stated under this section but shown in the GFC drawings / Particular specifications shall deemed to be included under the scope of this item.




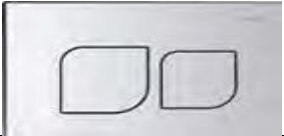


NIT No- AGIHF/Executing Agency/2024-25/01 date 27.08.2024

Suggestive Model of Sanitary Fixtures & CP Brass Fittings			
S.No.	Description	Model Number	Image
For Hospital (Except Private Ward), R&D Centre, Nurse Hostel, Resident Hostel, 2-BHK & 3 BHK Buildings			
1	European Water Closet	Jaquar Cat.No.FLS-WHT-5953 or Equivalent from Approve Make	
2	WC Connector	Kohler Cat. No. K-1046327-S or Equivalent from Approve Make	
3	Concealed Cistern	Jaquar Cat. No. JCS-WHT-2400S or Equivalent from Approve Make	
4	Face Plate for Cistern	Jaquar Cat. No. JCP-CHR-852415 or Equivalent from Approve Make	
5	WC Chair Bracket	Kohler Cat. No. K-1225108-0 or Equivalent from Approve Make	
6	Health Faucet	Jaquar Cat. No. ALD-577 or Equivalent from Approve Make	
7	Wash Basin under counter Rectangular	Jaquar Cat. No. FNS-WHT-40701 or Equivalent from Approve Make	
8	Wash Basin under counter Oval	Jaquar Cat. No. FLS-WHT-5701 or Equivalent from Approve Make	

9	Flat Back Wash Basin	Jaquar Cat. No. FLS-WHT-5931 or Equivalent from Approve Make	
10	CP Brass Waste	Jaquar Cat. No. ALD-727 or Equivalent from Approve Make	
11	CP Brass Bottle Trap	Jaquar Cat. No. ALD-769L300x190 or Equivalent from Approve Make	
12	Basin Mixer	Jaquar Cat. No. FLR-5001B or Equivalent from Approve Make	
13	Pillar Faucet	Jaquar Cat. No. FLR-5015 or Equivalent from Approve Make	
14	Touch Less Basin Mixer	Euronics Cat. No. ET02HC or Equivalent from Approve Make	
15	Urinal Basin All Building Except Resident Hostel	Jaquar Cat. No. URS-WHT-13255 or Equivalent from Approve Make	
16	Urinal Sensor	Jaquar Cat. No. SNR-CHR-51097 or Equivalent from Approve Make	
17	Urinal Basin For Resident Hostel	Jaquar Cat. No. URS-WHT-132530 or Equivalent from Approve Make	
18	Self-Closing Flush Valve for Urinal Flushing	Jaquar Cat. No. PRS-073 or Equivalent from Approve Make	

19	Toilet Paper Holder	Jaquar Cat. No. AKP-35751P or Equivalent from Approve Make	
20	Hand Drier	Euronics Cat. No. EH 26 NW or Equivalent from Approve Make	
21	Soap Dish	Jaquar Cat.No.AKP-35731P or Equivalent from Approve Make	
22	Angle Valve	Jaquar Cat. No. FLR-5053N or Equivalent from Approve Make	
23	Connecting Pipe 450mm Long Braided Hose	Jaquar Cat No. ALD 803AB or Equivalent from Approve Make	
24	Two Way Bib Cock	Jaquar Cat. No. FLR-5041N or Equivalent from Approve Make	
25	One Way Bib Cock	Jaquar Cat. No. FLR-5047N or Equivalent from Approve Make	
26	Twin Coat Hooks	Jaquar Cat. No. AKP-35761P or Equivalent from Approve Make	
27	Sink Mixer	Jaquar Cat. No. FLR-5165 or Equivalent from Approve Make	
28	Swing Handicap Grab Bar	Euronics Cat No. EGR-S02 or Equivalent from Approve Make	
29	Grab Rail 600 mm	Euronics Cat No. EGR-01 or Equivalent from Approve Make	

30	Liquid Soap Dispenser	Euronics Cat No. ES-31 or Equivalent from Approve Make	
31	Indian type Orissa pattern WC pan	Hindware Cat. No. 20042 or Equivalent from Approve Make	
32	Flushing Cistern	Hindware Cat. No. 511856 or Equivalent from Approve Make	
33	CP brass Wall Mixer	Jaquar Cat. No. FLR-5273UPR or Equivalent from Approve Make	
34	Shower Head	Jaquar Cat.No.OHS-1799 or Equivalent from Approve Make	
35	Shower Arm	Jaquar Cat.No.SHA-483 or Equivalent from Approve Make	
36	SS Kitchen Sink	Jayna Cat. No. SBS04 or Equivalent from Approve Make	
37	Hot Water Heater	Venus Cat. No. 25GV or Equivalent from Approve Make	
38	CP Brass Towel Ring	Jaquar Cat. No. AKP-35721P or Equivalent from Approve Make	
39	CP Brass Towel Rail	Jaquar Cat. No. AKP-35711P or Equivalent from Approve Make	
40	Water Cooler	Blue Star Model. SDLX 15150 or Equivalent from Approve Make	

S.No.	Description	Model Number	
For Guest House & Private Ward of Hospital			
1	European Water Closet	Jaquar Cat.No.KUS-WHT-35953 or Equivalent from Approve Make	
2	WC Connector	Kohler Cat. No. K-1046327-S or Equivalent from Approve Make	
3	Concealed Cistern	Jaquar Cat. No. JCS-WHT-2400WS or Equivalent from Approve Make	
4	Face Plate for Cistern	Jaquar Cat. No. JCP-CHR-852415 or Equivalent from Approve Make	
5	WC Chair Bracket	Kohler Cat. No. K-1225108-0 or Equivalent from Approve Make	
6	Health Faucet	Jaquar Cat. No. ALD-577 or Equivalent from Approve Make	

7	Flat Back Wash Basin	Jaquar Cat. No. FLS-WHT-5931 or Equivalent from Approve Make	
8	CP Brass Waste	Jaquar Cat. No. ALD-727 or Equivalent from Approve Make	
9	CP Brass Bottle Trap	Jaquar Cat. No. ALD-769L300x190 or Equivalent from Approve Make	
10	Basin Mixer	Jaquar Cat. No. KUP-35011BPM or Equivalent from Approve Make	
11	Toilet Paper Holder	Jaquar Cat. No. AKP-35753P or Equivalent from Approve Make	
12	Soap Dish	Jaquar Cat.No.AKP-35731P or Equivalent from Approve Make	
13	Angle Valve	Jaquar Cat. No. KUP-35053PM or Equivalent from Approve Make	
14	Connecting Pipe 450mm Long Braided Hose	Jaquar Cat No. ALD 803AB or Equivalent from Approve Make	
15	Two Way Bib Cock	Jaquar Cat. No. KUP-35041PM or Equivalent from Approve Make	

16	One Way Bib Cock	Jaquar Cat. No. KUP-35037PM or Equivalent from Approve Make	
17	Twin Coat Hooks	Jaquar Cat. No. AKP-35761P or Equivalent from Approve Make	
18	Liquid Soap Dispenser	Euronics Cat No. ES06N or Equivalent from Approve Make	
19	CP brass Shower Mixer Diverter	Jaquar Cat. No. KUP-35079KPM + ALD-079 or Equivalent from Approve Make	
20	Shower Head	Jaquar Cat. No. OHS-1709 or Equivalent from Approve Make	
21	Shower Arm	Jaquar Cat. No. SHA-455L400 or Equivalent from Approve Make	
22	Bath Spout	Jaquar Cat. No. SPJ-35429PM or Equivalent from Approve Make	
23	CP Brass Towel Rail	Jaquar Cat. No. AKP-35711P or Equivalent from Approve Make	

List of Approved Makes

LIST OF APPROVED MAKE (Plumbing & Fire Fighting)

	Plumbing Works			
1.	Sanitary Fittings & Accessories	Jaquar Euronics	Kohler	Hindware
2.	CP Brass Fittings	Jaquar Euronics	Kohler	Hindware
3.	G.I. / M.S. Pipe	Tata	Jindal (Hissar)	Sail
4.	G.I. Fittings	Unik	New	Zoloto-M
5.	SS Pipes	Jindal Stainless Ltd. VSH	Alfa Press Aquinox	Viega
6.	DI Pipes / Fittings	Electro steel	Jindal	Tata Ductura
7.	Float Valve	IVC KSB	Leader DRP	Zoloto
8.	uPVC Pipe and Fittings	Astral Prince	Supreme AKG	Finolex Ashirwad
9.	CPVC Pipes & Fittings	Astral Prince	Supreme AKG	Finolex Ashirwad
10.	Polypropylene (PP) Pipes & Fittings (Sound Insulated)	REHAU	WAVIN	POLOPLAST
		ASTRAL		
11.	FRP Manhole cover with Frame	THERMODRAIN	DUDHI	
12.	SFRC Manhole covers & gratings	KK manhole Grating Co. Pvt Ltd T-CON	OCR OM Spun	Pragati Local ISI Marked
13.	Forged Brass Ball Valve	Leader	Sant	Zoloto
14.	CI Butterfly, Dual Plate Check Valve	Leader	Sant	Zoloto
15.	Liquid Soap Dispenser	Euronics	Utec	Jaquar
16.	Water Meter	Kranti Capstan	Zoloto Kent	Leader Marshal
17.	Non-Return Valve	Leader	Sant	Zoloto
18.	Polyethylene water storage tank	Sintex Vectus	Supreme QUTONE	Sheetal
19.	Insulation for hot water pipes	Kaiflex Lloyd	Armaflex Twiga	Careflex Thermafex
20.	Stainless Steel Sink	Neelkanth	Nirali	Jayna
21.	HDPE DWC Pipes	Supreme Finolex	Astral	Ashirwad
22.	Gully Traps	ISI Marked		
23.	RCC Pipes	ISI Marked		
24.	SS Gratings	Camry	Chilly	Cardin
25.	Air Release Valves	Zoloto	Sant	Leader
26.	CI Double Flanged Sluice Valve	Kirloskar Leader	Sant Advance	Zoloto Kartar
27.	Solar Water Heating System	Solarhart	Greentek	Inter Solar
28.	Hand Drier	Euronics	Utec	Jaquar
29.	Drinking Water Cooler	Blue Star	Voltas	Usha
30.	Anti-Vibration Mounting & Flexible connections	Resisto flex	Dunlop	Flexionics
31.	Digital Flow Meter	Energy	Honeywell	Cirrus

				Engineering
32.	Temperature Sensor / Gauge	Forbes Marshall	Danfoss	Wika
33.	Pipe clamp & supports	Intellotech	Euroclamp	Indotech
34.	Pressure Gauge	Fiebig	H.GURU	HD/BRC
35.	Paints	Asian	Berger	Shalimar
57.	Heat Pump	AO Smith	Bluebox,	Greentek
FIRE FIGHTING				
1.	G I / M S Pipes	Tata	Jindal (Hissar)	SAIL
2.	Forged Fittings	SS	VS	True Forge
3.	ERW / Butt Welded Fittings	MEC (Jainsons)	Unik	DRP
4.	Forged Brass Ball Valve	As listed in Plumbing		
5.	CI Butterfly Valve	As listed in Plumbing		
6.	Motorized Butterfly Valve	AIP	Zoloto	CASTLE
7.	Pot / Y / Suction Strainer	Zoloto	Sant	Leader
8.	Non-Return Valve	Zoloto	Sant	Leader
		Kartar	Kirloskar	Audco
9.	Thermometer	As listed in HVAC section		
10.	PICB Valve	As listed in HVAC		
11.	Installation Control Valve	HD	Viking (VL Listed)	Victaulic
12.	Air Release Valves	Zoloto	Sant	Leader
13.	C.I. flanged / Dual Plate / Wafer Type / Disk type sluice / Non-return valves	Zoloto	Sant	Audco
		Advance	Leader	
14.	Foot valve with Strainer	Kirloskar	Leader	Zoloto
15.	Fire Extinguishers	Safeguard	Minimax	Lifeguard
		Ceasefire	Newage	Kalpex
16.	First Aid Hose Reel Drum / Thermo Plastic Hose Reels for Drums / R.R.L. Hose & C.P. Hose / Branch Pipe / Nozzle / Coupling / Landing Valves / Fire Brigade Connections / Fire Fighting Equipment not covered elsewhere	Safe Guard	Minimax	Lifeguard
		Newage	Kalpex	
17.	Sprinkler Head & Rosette Plates	Tyco	Viking	HD
		Lifeguard	Newage	
18.	Flexible Connector (Drop) for Sprinkler	Safeguard/Lifeguard	Viking	Kalpex
19.	Flow Switches	System Sensor	Honeywell	Potter
		Tyco		
20.	Inspection Test valve / Alarm Valve / Deluge Valve	Viking	Tyco	HD
		Newage	Victaulic	Giacomini
21.	Pre-Fabricated Structural supports and clamps	Chilly	Hitech	Camry
		Easyflex	Mupro	
22.	Pressure Gauge	As listed in Plumbing		
23.	Anti suction & delivery flexible pipe connectors	Easyflex	Resisto flex	Dunlop
		Kanwal Industrial Corporation		
24.	Rubber Bellow	Kanwal Industrial Corporation	Resistoflex	Dunlop

25.	Anti-Vibration Pad	Cori Dunlop	Diamond Pipe Support	Easyflex
		Flexionics	Resisto flex	Emerald
26.	Fire Pumps	Wilo/Matter platt	Kirloskar	KSB
27.	Electrical Switch Gears	As per Electrical make list		
28.	Power and Control Cables	As per Electrical make list		
29.	Control Panel of Terrace Pumps (CPRI Approved)	Advance panel & Switchgear	Adlec	Tricolite Elect Industry
		SPC Electrotech	Ambit	RST
		Neptune	Precision Control	
30.	Voltmeter & Ammeter	Schneider	Neptune	Rishabh
		Conserve		
31.	Indicating Lamp and Selector Switches	BCH	Rishabh	Conserve
32.	CT/PT	AE	Kappa	Nutech
33.	MCCB / MPCB / MCB / RCCB	Siemens	Schneider	Legrand
		ABB	Havells	L&T
34.	Contractors / Times, Overload Relays	L&T	Siemens	Schneider
35.	Annunciation panels	PCD	Agni	Tricolite
		Adlec		
36.	Single phase preventer	Minilac	L&T	Siemens
37.	Anti Vibration Mounting	Kanwal Industrial Corporation	Resistoflex	Ewren
38.	Starter	L&T	Siemens	Crompton
		GE	ABB	BCH
39.	Current Transformer (Cast Resin)	AE	L& T	Kappa
PUMPS AND WATER TREATMENT SYSTEM				
1.	Pumps / Submersible Drainage Pumps	Grundfos	Xylem	WILLO
		KSB		
2.	Ball Valves	As listed in Plumbing/Fire Fighting System		
3.	Butterfly Valve/Y-Starainer	As listed in Plumbing/Fire Fighting System		
4.	C.I. double flanged sluice valve	As listed in Plumbing/Fire Fighting System		
5.	Non Return Valve	As listed in Plumbing/Fire Fighting System		
6.	Float Switch	Nolta	Danfoss	Honey Well
7.	Pressure Gauge	As listed in Plumbing/Fire Fighting System		
8.	Dosing system	Milton Roy	Asia LMI	Pent air
9.	Liquid Level Controllers / Liquid Level Indicator	Advance	Honey Well	Danfoss
10.	Filter / Softener	Ion Exchange	Renaissance Aqua	Pentair
11.	Salt Saturator	Ion Exchange	Renaissance Aqua	Pentair
12.	Water Meter	As listed in Plumbing & Sanitary		
13.	Vessels	Astral	KGM	Structural
14.	Mechanical Seal	Burgmann	Sealol	
15.	Grease Trap / Separator	ACO	Wade	Kassel
SEWAGE TREATMENT PLANT (STP)				
1.	C.I. double flanged sluice valve	As listed in Plumbing & Sanitary		
2.	C.I. Disk Type non return valves	As listed in Fire Fighting		
3.	PVC Valves	Ashirvad	Astral	Supreme

4.	D.I. Manholes cover	RPMF/ SKF/ NECO/ SIF		
5.	Plastic Encapsulated Foot Rest	KGM	KK	
6.	Filter feed pump / Hydro-Pneumatic Pumping Systems	Grundfos	Xylem	WILO
		KSB		
7.	Submersible Sump Pumps for collection chamber, equalization tank, Plant room drainage, Filter backwash sump	As per Pumps and Water Treatment system		
8.	Pressure Transmitters / Hydrostatic Level Indicators	WIKA	Siemens	Johnson Control
9.	Pressure Gauges	As listed in Plumbing/Fire Fighting System		
10.	Dosing System	As per Pumps and Water Treatment system		
11.	Vibration Pads / Suction / Delivery Flexible Connectors	As listed in HVAC / Ventilation system		
12.	Pressure Sand & Activated carbon filter	M.S. Prefabricated		
13.	Air Blowers	Everest	Beta	ABL
14.	Ultra Violet Disinfection for Treated Effluent	Alpha UV	Sukrut	Neotec
15.	Air Diffusers	BOBKAY	MM Aqua	REHAU
16.	MBR Module	Toray	Suez	Berghof
17.	Dosing Pumps / system	As per Pumps and Water Treatment system		
18.	Sludge Pumps (Centrifugal)	Kirloskar	Grundfoss	Xylem
		Johnson		
19.	Sludge Pumps (Screw)	Roto	UT Pumps	Stork
20.	Tube Settler media	MM Aqua	PP Aqua	Tecpro
21.	Centrifuge	Hiller	Alpha	Humboldt Wedag
22.	Pressure Gauge	As listed in HVAC / Ventilation system		
23.	Level Gauge	H. Guru	Fiebig	WIKA
24.	PH Meter / Conductivity Meter / DO Meter / TDS Meter	Hach	Toshniwal	Ionix
		Oakton		
25.	Ultra Violet Water Purifier (WTP / STP)	Alfa UV Mumbai	Pentair	Eureka
26.	Syphonic Roof Drainage System	Geberit	Saint Gobain	Wavin
27.	Ozonisation System	Oraipl	Ozonics	Voltas
28.	Geared Motor	Bonfiglioli	Grease Cotton	Motova Rio
29.	Exhausters	Nicotra	Kruggler	Green Heck
30.	Compost Plant	Excel, Smart Enviro Bombay	Ecoman	Clean India
31.	Solid Waste Handling and Conveying	Env Tech (P) Ltd.	Rosa Roca	
32.	Clear water pump	Grundfos/KSB	Xylem	WILO
33.	Panel Boxes (For PLC)	RITTAL / BCH/DELTA		
34.	Electromagnetic flow Meters	KENT / MARSHALL/IOTA		
35.	Lighting distribution board	Controls & Switchgear/Havells/UDM		
36.	Ultra Violet Disinfection for Treated Effluent	ALFA / SUKRUT/TROJAN		
37.	Ozonator	Creative/Am Ozonics		
38.	Testing Meters	ABB / SIEMENS/ L&T		
39.	Online monitoring system	TETHYS/XYLEM/FORBES MARSHALL		
40.	Ultrafiltration system	QUA/GE/HYDRONAUTICS		
41.	Reverse osmosis membrane	GE/HYDRONAUTICS/TORAY		
42.	FRP vessels & MCF	Pentair/Thermax/Amtek		
43.	Media	Cooldeck/Usha Ruba/MMAqua/Pharmatech		
44.	STP Vendors	Premier Brisanzia / Degrimont / Thermax /JEM/DOSHION /		

		Seema Lab
45.	Gas Flooding System/Equipment	Safety Hitech, Italy/Rotarex/ Firetrace/ Kalpex
46.	Gas Flooding Vendor	Pyroguard Engineers/ Ceasefire / Lifeguard/Tyco/ Firetrace/ Kalpex

PART 2

ELECTRICAL & ALLIED WORKS

ELECTRICAL WORK

SCOPE OF WORK

SCOPE OF WORK AND BRIEF DESCRIPTION OF ELECTRICAL SUB-STATION WORKS

ELECTRICAL SYSTEM

Electrical & Allied Services' required for proposed AAHII in IIT(G) campus covers Electric Sub Stations, D.G Set Installation work, Internal Electrical Installations, HT/ LT Panels, Hybrid Power Factor Correction Panel, Distribution Boards, External Electrical Installations, 33 KV HT and LT Cables, Road/ Compound Lighting, Centralized UPS system, Internal & External Electrical Distribution work. It shall also include Direct Online Solar power station, Telephones System, Data, LAN Networking & Wi-Fi System, CCTV system, Fire Alarm System, Evacuation System, Building Management System, Electrical Distribution, Access Control System, MATV System, Hospital Management Information System (wiring only), Lifts etc.

General Services in the scope of E&M Work (Sub-Station and Service Building)

The services to be provided by Contractor shall include following services.

- 33 KV/0.433 KV Substation of capacity 3 x 2500 KVA (02 no. working & 01 No. standby) for Complete project comprising of TTA H.T. Panel having one spare outgoing HTVCB, oil type transformers, HT Cable, TTA MV main Panels receiving supplies from transformers and DG sets through sandwich type Aluminium bus trunking, Other Distribution Panels etc. inter connecting power cables in sub- station, Automatic power factor correction panel, TTA Essential Panel, Active Harmonic Filter, TVSS, surge protection system i/c copper & GI Plate Earthing, inter connecting power cables in sub- station, Aluminium XLPE armoured cable from LT and TTA Emergency Panel to main panel of each block and from block panel to End Feed Unit of Alu. Rising Mains LT cables from Sub-Station to Lifts, Fire fighting system, drinking water pumps, AC Plant, STP Plant and other major services etc. and safety equipments. Planning comprising of calculation of electrical load complete with EI & medical and other equipment loads of the building and electrical load of AC Plant and other E&M equipments and calculation of total working capacity of the transformers considering diversity factor of the system, making SLD shop drawings for the distribution system, sizes of cables as per loads etc. are in the scope of work.
- Provision of 4 X 1500 KVA (04 no. working) silent type D.G. Set, TTA AMF cum Synchronisation panel complete with Automatic load transfer facility/TTA type synchronization panel using PLC with, Aluminium Bus Trunking from DG Set to essential panel, control cable, copper & GI Plate Earthing of DG Set as per CPWD specifications and exhaust piping as per CPCB norms with statutory approvals i/c supporting structure/arrangement is in the scope of this work. The facility of manual bye-pass arrangement from the normal supply shall be in the scope of the work in case of failure of TTA AMF panel and PLC etc. to ensure the availability of trouble free normal supply.
- Electrical installations & fans including all electrical fittings/fixtures, normal supply, generator supply, UPS supply, signages, signboards as necessary (as per GFC drawings and Technical Specification).
- SITC & Laying of fiber optic cables and other related accessories etc. (as per GFC drawings and Technical Specification).
- SITC of IP based CCTV system complete with PTZ, Fixed bullet and dome cameras, NVR, LED panels, control system, software, hardware etc. (as per GFC drawings and Technical Specification)
- Liaisoning with other statutory agencies like Fire Services, APDCL etc. for obtaining the pre-construction and post construction clearances. The statutory payments to these agencies

shall be paid by the contractor except payment for the service connection charges of HT line from the APDCL to the HT meter board for residential as well non-residential HT connection.

- To prevent storm water entering the transformer and switch rooms through the soak-pits, the floor level of the substation/switch room shall be at least 300 mm above the highest flood water level that may be anticipated in the locality or as directed by Engineer in charge.
- LT cable Trench of suitable size as per drawing shall be provided from sub-station to hospital blocks.
- HT cable shall be laid in HDPE pipe.
- HDPE pipe shall be used for road and paved area crossing.
- For other buildings LT cable shall be buried in ground as per CPWD specification.

Power Factor Improvement & Harmonics Suppression

Hybrid power factor correction panels with ultra-heavy-duty capacitors, Thyristor switched with 14% detuned reactor copper wound with 180% linearity Hybrid harmonic filters (Active& Passive) are proposed to be provided in the substations to achieve overall power factor 0.99 (lagging) from existing Power Factor, as per ECBC with operation in both Auto and Manual mode. Power factor Correction Panel shall be BMS Compatible. The capacitor panels with Hybrid Harmonic filters shall be provided in each substation to compliance in accordance IEEE-519 2023. Connection from Main LT Panel to Capacitor Panel is to be provided through Aluminum armoured cable. It should work on both Grid as well as DG Power. Hybrid panel should be totally type tested as per IS 16636:2017, IEC 61921, IEC 61439.

BOOM BARRIERS

Boom Barriers shall be provided at all Entry Gates of the AAHII at IIT-(G) Campus. Push Button Type Control for open & Close the Boom Barrier through high Torque motors operated through 230 V AC Supply. In case of power failure the barrier can be raised/lower manually. The Boom length shall be as per the requirement of the road Width. The Opening time varies from 3 sec. to 6 sec. The Control Unit shall be IP 54 protected against rough weather.

EXTERNAL/ STREET LIGHTING:

High efficiency LED lighting fixtures shall be provided (As per lighting schedule) for external road lighting, compound/ landscape lighting, façade lighting & Street Lighting. The lighting control/operation for external Lighting shall be automatically controlled with digital timer control switch through outdoor type Feeder Panels.

External LED Lighting proposed shall be the combination of conventional wired external lighting Poles.

Lighting shall be provided for external lighting of large open areas and parking area.

Road/ Compound Lighting/ Landscape Lighting/ Facade Lighting shall be provided as per NBC & ECBC Codes. Road/ compound lighting shall be provided with outdoor type light fittings (IP-65). LED lighting shall also be provided at selected locations as per GRIHA 3 requirement.

LED Façade lighting shall be provided to illuminate the building elevation.

All LED Street Light Poles shall be made out of Galvanized Iron (GI) Octagonal tubes. Poles (as per GFC drawing) will be suitable for single/ double side arms or as required. Poles shall have a service window at the bottom comprising connector terminal & MCB. Poles can be mounted on foundation with Anchor bolts of suitable size & quantity. The height & spacing of the LED street light poles pole will be provided to achieve illumination Lux levels. The height & spacing of pole and illumination Lux level should be as per latest CPWD Specifications, NBC 2016 and other relevant norms.

Suitable outdoor type feeder panel with digital time controlling shall be provided for power distribution of various circuits of LED Street Lighting Poles/ Bollard/Façade light etc.

A. INTERNAL ELECTRIFICATION, LV & ALLIED WORKS:

Following works shall be carried out in coordination with the civil work within the buildings complete in all respects strictly as per CPWD Specifications latest up to date, latest IS Codes, NBC -2016.

- Wiring & Conduiting (MS Conduits for hospital) for internal electrification, LV & Allied works. Conduits for all other building shall be PVC ISI marked (As per DSR).
- Fire Survival Cable shall be used for Fire Alarm system.
- LED Light fixtures (As per Lighting Schedule), Fan (Ceiling & Wall) & Exhaust Fans.
- 6A Light Point Modular Switch & Socket Outlets.
- 16A/ 20A Power Modular Switch & Socket Outlets
- L.T. Cables and Sub main wiring, circuit wiring.
- Cable Tray.
- Floor Panels, Distribution Boards & VTPN DBs.
- Earthing system.
- Extra Low Voltage system like Telephone, IPBAX, Wi-Fi, Fire Detection & Alarm System, CCTV System, Evacuation system etc.

ELECTRICAL LOAD

S. No.	Description	Area	Connected	DF	Demand
		(Sqm.)	Load (kW)		Load (kW)
1	Hospital Block	37395.00			
a)	Lighting load @ 9.7W/sqm		362.7	0.8	290.2
b)	Power load @ 55W/sqm		2056.7	0.5	1028.4
2	R&D & Academic Block	7385.45			
a)	Lighting load @ 11.2W/sqm		82.7	0.8	66.2
b)	Power load @ 55W/sqm		406.2	0.5	203.1
3	Services Area	1879.00			
a)	Lighting load @ 14.1W/sqm		26.5	0.8	21.2
b)	Power load @ 55W/sqm		103.3	0.5	51.7
4	Residential, Hostel & Guest House Blocks	12944.00			
a)	Lighting load @ 9.1W/sqm		117.8	0.6	70.7
b)	Power load @ 55W/sqm		711.9	0.3	213.6
	*Lighting Load (As per ECBC-2017 Building Area Method)				
	**Power Load (As per NBC-2016, 55 W/Sqm with diversity 50%)				
5	Small & Heavy Medical Equ. Load		1307.5	0.7	859.1
6	Kitchen Equ. Load (Assumed)		125.0	0.7	87.5
7	Laundry Load (Assumed)		160.0	0.7	112.0
8	Lift - 16 Nos. @ 16 kW each		256.0	0.8	204.8
9	Lift - 16 Nos. @ 10 kW each		160.0	0.8	128.0
10	HVAC Load (1500 TR)		1950.0	0.7	1365.0
11	VRV (100 HP)		100.0	0.7	70.0
12	Ventilation		100.0	0.7	70.0
13	Plumbing load		211.1	0.7	147.8
14	Fire Fighting system - Equipments		160.4	Jockey Only	11.2
15	STP & ETP load		82.1	0.8	65.6
16	Electric Vehicle Charging Load		75.0	0.2	15.0
17	External Lighting		25.0	0.8	20.0
18	Miscellaneous		50.0	0.8	40.0
	Total load in kW		8630.0		5141.0
	Selection of Transformer				

Total Maximum Demand in kW		5141.0
Maximum Demand in kW with overall diversity @ 70%		3598.7
Demand load in kVA @ 0.9 pf		3998.5
Transformer selection in kVA @ 80% loading		4998.2
Transformer Selected	3 x 2500 kVA (2W + 1S), 33KV/ 433V, Oil Type	
Selection of Diesel Generator (DG)		
Total Maximum Demand in kW		5141.0
Maximum Demand in kW with overall diversity @ 75%		3855.7
Demand load in kVA @ 0.8 pf		4819.7
DG selection in kVA @ 80% loading		6024.6
DG Selected	DG Selected - 4 x 1500kVA, 415 V, Air cooled	

ELECTRICAL LOAD DETAILS FOR MEDICAL EQUIPMENT DETAILS							
S.No.	Description	Qty.	Equipment Load (In KVA)	Equipment Load (In KW)	CL in KW	DF	DL in KW
1	MRI	1	150	135	135	1	135
2	CT	2	250	225	450	0.6	270
3	OT	11	11.11	10	110	0.6	66
4	Ultrasound	2	2.78	2.5	5	0.8	4
5	Dexa	1	20	18	18	1	18
6	Mammography	1	30	27	27	1	27
7	X-RAY (Digital)	3	112	100.8	302	0.6	181
8	Cath Lab	1	2.22	2	2	1	2
9	LDR	1	2.22	2	2	1	2
10	Dialysis (11 Beds)	11	1.83	1.65	18	0.6	11
11	CSSD	1	264.4	238	238	0.6	143
TOTAL					1308kW		859kW

Note:

- Contractor shall prepare shops & coordinated drawings with respect to all MEP & Medical services drawings and got approved from Engineer-In-Charge before start of work.

- Laying of HDPE pipe, manhole, sleeves etc. for road crossing, entering in to the building shall be in contractor scope.
- The scope of the work of contract includes Quality Assurance Policy & Check List of E&M Services as per CPWD Hand book as amended upto date and obtaining mandatory approvals from local bodies/ State & Central authorities/ Municipal Corporation, Environment clearance, NOC from Assam Fire Department etc. The scope of work also includes two years defect liability period of all E&M services as mentioned above. LED fittings and fixture shall be with the warranty for five years from the date of completion and handing over the site to the client department.
- Main switch along with cable, cable tray etc. shall be provided by contractor for following areas
MRI, CT scan, X-Ray & Cath Labs etc.
- There will be no any extra cost paid against sifting of power points as per site requirement.

SCOPE OF WORK AND BRIEF DESCRIPTION OF ELECTRICAL WORKS (HOSPITAL BLOCK)

ELECTRICAL SYSTEM

Building shall conform to CPWD Green Building manual (Green/ Green plus/ Green Premium) as required and Equipment shall conform to GRIHA 3 as required.

Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Rising mains, Cables, Cable Trays, Ducts, etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cutouts, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.

All Services as required like electrical power, telephone points, LAN/Data points, UPS points, raw/ soft/ etc. shall be adequately provided by the EPC Contractor.

General Services in the scope of Electrical Work (Hospital)

The services to be provided by Contractor shall include following services.

- Electrical installations & fans including all electrical fittings/fixtures, rising mains for normal supply, generator supply, UPS supply, signages, signboards as necessary (as per GFC drawings and Technical Specification).
- SITC of Lightning protection and Earthing system (as per GFC drawings and Technical Specification).
- SITC of UPS back up as per requirements supported by calculations & GFC drawings/ Technical Specification.
- SITC of Lifts (as per GFC drawings and Technical Specification/Lift Schedule).
- SITC of LAN & IP based EPABX system (as per GFC drawings and Technical Specification).
- SITC of IP based CCTV system complete with PTZ, Fixed bullet and dome cameras, NVR, LED panels, control system, software, hardware etc. (as per GFC drawings and Technical Specification)
- SITC of Fire Detection/Alarm and Evacuation system (as per GFC drawings and Technical Specification).
- SITC of Solar PV generation (as per GFC drawings and Technical Specification).
- Liaisoning with other statutory agencies like Fire Services, APDCL etc. for obtaining the pre-construction and post construction clearances. The statutory payments to these agencies

shall be paid by the contractor except payment for the service connection charges of HT line from the APDCL to the HT meter board for residential as well non-residential HT connection.

B. INTERNAL ELECTRIFICATION, LV & ALLIED WORKS:

Following works shall be carried out in coordination with the civil work within the buildings complete in all respects strictly as per CPWD Specifications latest up to date, latest IS Codes, NBC -2016.

- Wiring & Conduiting MS Conduits for internal electrification, LV & Allied works.
- Fire Survival Cable shall be used for Fire Alarm system.
- LED Light fixtures (As per Lighting Schedule), Fan (Ceiling & Wall) & Exhaust Fans.
- 6A Light Point/UPS Modular Switch & Socket Outlets (Anti Bacteria).
- 16A/ 20A Power/UPS Modular Switch & Socket Outlets
- L.T. Cables and Sub main wiring, circuit wiring.
- Cable Tray.
- Rising Mains, End Feed units.
- Distribution Boards & VTPN DBs.
- Main Distribution panels for light, power, AHU's, Lift, Ventilation, OT's & UPS panel at all floor.
- Earthing & Lighting Protection system.
- Extra Low Voltage system like Telephone, IPBAX, LAN & Wi-Fi, Fire Detection & Alarm System, CCTV System, MATV, Evacuation system, Access control system etc.
- Separate conduit shall be used for separate submain circuit.

Following points shall be generally followed for internal and external electrification of various areas:

- Internal areas like rooms, corridors, lobbies, staircases, terraces, washrooms etc. of all buildings and blocks shall be adequately illuminated conforming to provisions stipulated in NBC 2016, ECBC and CPWD technical specifications maintaining the indicated Lux levels and Light Power Density.
- The Internal Electrification work shall be carried out in recessed/surface mounted MS conduits only in accordance with CPWD General Specifications for Electrical Works Part-I (Internal)-2023 and Part-II (External)-2023 with up to date amendments.
- MS Conduits shall be surface mounted or laid on MS angle/channels with suitable hanging supports in areas wherever there is false ceiling provision. In case there is no provision for false ceiling, MS Conduits shall be concealed in concrete during slab casting. Wiring for lighting/power, & LV work wiring shall be done in MS Conduits.
- FRLS PVC insulated Copper conductor wires will be used for points, circuit wiring conforming to relevant IS-Codes.
- Agency shall execute the work after obtaining necessary approval of the layout for internal electrification of Hospital, common areas and staircases etc. The staircase lighting shall be in group control system.
- Modular type switches (Anti Bacteria), sockets and stepped type electronic fan regulators, bell push button along with matching mounting boxes of same make shall be used.
- Colour coding of the conduits, switches, sockets shall be provided for Normal & UPS power supply as per NBC 2016.
- TV outlet point wiring shall be terminated in suitable size of G.I. box along with splitter as per GFC drawings or as per requirement. The interconnections of all splitter boxes fixed at all floors shall be done properly with conduits to form proper distribution system with the prior approval of Engineer-in-charge.

- LED Type Lighting fixtures shall be provided as per Lighting Schedule.
- Ceiling fans & wall fans are not required however if required or as directed by Engineer-in-charge contractor shall provide the same without any extra cost.
- Separate shafts shall be provided for laying of pipes for Electrical, ELV, Mechanical and Fire Services as per GFC drawings.
- After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2023 & Indian Electricity Rules 2005 amendment upto date, shall be recorded and submitted. The results shall be within the permissible limits.
- Suitable illumination with LED light fixture shall be provided on terraces as per lighting Schedule.
- Power Points, LAN points, UPS power point, Telephone Point (with telephone instrument as required) shall be provided for all counters like registration, reception, nurse call station etc.
- Light fixture shall be provided as per GFC drawings & Lighting Schedule.

C. LIGHTING DESIGN & LIGHTING FIXTURE

LED lighting fixtures shall be provided with inbuilt Harmonic suppression system in all areas as to achieve the illumination levels conforming to latest IS Code, NBC 2016, ECBC latest up to date and as per Technical Specifications. All LED lighting Fixture shall have luminous efficacy of more than 120 Lumens per watt. Lighting Power Density (LPD) shall be as per lighting simulation requirements as per GRIHA 3 & ECBC norms. Contractor shall provide special light fixture for Helipad.

Tunable LED lighting fixtures shall be provided with inbuilt Harmonic suppression system in ICU, IPDs & IPD corridor areas as to achieve the illumination levels conforming to latest IS Code, NBC 2016, ECBC latest up to date and as per Technical Specifications

D. COMPUTER/ LAN NETWORKING/ WI-FI POINTS

Foiled shield CAT6 ACABLES & COMPONENTS, FIBER OPTICS CABLE & COMPONENTS

- Complete installation shall be done in accordance with installation practices for a well-structured cabling system, using components from a single vendor to ensure consistent and assured performance. The structured cabling distribution network shall serve as a vehicle for transport of data, video and voice telephony signals over a common network throughout the network.
- Installation, termination and identification of wiring between station outlets and networking rack shall be considered part of the contractors work.
- Wiring utilized for data and voice communications shall originate at networking racks and terminate at IOs terminated at wall.
- All cables and terminations shall be identified at all locations.
- All balanced twisted pair cable terminations shall comply with, and be tested to TIA/EIA568-C.2 standards for CAT 6A installations.
- Standards Compliance:-shielded twisted pair cabling system, conforming to ANSI/TIA/EIA 568-C.2 CAT 6A cabling system, ISO/IEC 11801 2nd edition, EN-50173-1.
- The contractor shall carry out & shall make the system entirely operational for its intended use, by addition of components specific to its make/model even if not specifically mentioned in the TS.
- It shall be the responsibility of the installer and OEM manufacturer to ensure that the Passive Components of structured cabling distribution network will be free from manufacturing defects in material and workmanship under normal and proper use.

- The site will be duly certified by OEM for a period of 25 years from the date of issuance of the registration certificate or installation, whichever is earlier.
- 25-year product guarantee by the OEM/ manufacturer along with system performance guarantee by Penta scanning reports and actual test results conducted at site such as attenuation, return loss, NEXT & ACR. Permanent link shall be tested for minimum guaranteed performance as per standards at 500 MHZ operation minimum.
- The Supplying, installation, testing and commissioning of FOILED SHIELD CAT6A data cables shall include supply and laying of cables in MS conduit on ceiling/ wall/ slab etc.

Cat 6A RJ 45 data outlets points will be provided for Computers, Networking, Telephones, Wi-Fi, Access Control, CCTV, Information Display system, BMS etc. as per requirement in rooms and other areas as drawings provided. To protect Cat 6A outlets from authorized/unauthorized insertion of cords or foreign objects and/or deter unintended or unauthorized disconnection of cords, Outlet adapter lock and secure patch cord solution to be used which utilizes universal keys to provide secure and tamper proof connections.

The Data Outlet points shall be connected to Rack Panel/Computer hub with 4 pair CAT-6A wiring in recessed/ surface MS conduit as required. UPS Power supply shall be provided to Network Rack, Servers & Computers wherever required.

The maximum length of the CAT-6A cable from end user point to the Hub or Edge switches shall not be more than 70 M. Beyond 70 M length Fiber Optic Cable shall be used.

The Rack Panel/computer hub at various floors will be connected to Main rack of the block with Fiber Optic Cable through MS conduit or on surface/ recess.

Suitable Server shall be placed in a room with false flooring shall be established in Hospital Building, which comprises both LAN server & IPABX server. There shall be proper redundant (24 X 7) cooling facility in the server room to maintain the desired temperature, humidity & Indoor air quality for smooth operation of the System.

A redundant LAN server will also be provided.

The Server shall have Firewall protection, Bandwidth management & required client Access license.

The incoming Fiber cable from Service provider for the Campus Broadband connectivity shall be terminated in the Server room. The laying and termination of Fiber optic cable within the campus will be provided.

The Rack Panel comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, Trans-receivers, Fiber patch cord etc. of individual floor floors.

LAN Infrastructure at different Floors shall be used commonly for IPABX, BMS, Access Control System, CCTV, Nurse Call System, HMIS (Hospital Management Information System) etc. along with LAN.

Color coding management: Different color I/O will be provided for the different services at I/O and Rack end to identify the all services by color. Patch cord should be with different color interchangeable rings on the patch cord to identify different services and this should help avoiding to manage the stock of multiple patch cords for maintenance purpose.

Field terminated plugs made for CAT-6A will be used for any device to be installed in ceiling (For Ex-Camera, WI-FI, etc.) for improved performance and more efficient power deliveries by eliminating extra connection points for patch cords and outlets. Cat6A cable and field terminated plug should be of same make for system performance guarantee by the OEM.

For HMIS, only wire/cable network with copper cables/CAT-6A/Optical Fiber Cable shall be provided as required.

Wireless access points for Wi-Fi connectivity are proposed in entire building however, Common area, waiting area are to be provided with Wi-Fi connectivity, whereas other work station area in the building shall be with wired data outlets along with the Wi-Fi connectivity.

LAN system shall comprise of nodes (as per GFC drawings) and having appropriate quantity of access point for covering the complete Hospital building. It also includes necessary

backbone active and passive infrastructure like Cat 6A cable, Fibre Optic cable, networking L-2 & L3 switches, patch panels, patch cords, NMS, Access points for wi-fi, controllers etc. as per the Tender specifications and GFC drawings.

Note:

- Voice and Data Communication System May share same back bone IT infrastructure.
- Server & Software part are not in contractor scope.
- Heat MAP to be provided by contractor speed of data for farthest point should be 200MBPs.

E. PURE SERVER BASED IPABX SYSTEM

RJ-45 Telephone socket outlets with suitable IP Phones instruments shall be provided at convenient locations & as per drawings provided. CAT-6A wiring shall be provided in recessed/surface MS conduits from each telephone point up to the Rack panel (Patch Panel & Switch) at each floor or nearest Rack Panel of Floor. The Maximum length of the CAT-6A cable shall be 90 M.

IPABX with minimum capacity of 600 Telephones & expandable up to 1000 telephones shall be located at Server Room in the Hospital block. The PRI lines for IPABX shall be terminated in the separate Rack in server room of Hospital Block. This Rack will be connected to the IPABX system.

The Rack Panel (comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, Trans receivers, Fiber patch cord etc.) of individual buildings/Blocks shall be connected to the main IPABX Server Rack with optical Fiber cables to be laid underground in DWC HDPE Pipe of suitable size.

Manholes with covers shall be provided in the underground DWC HDPE pipes at suitable lengths for easy pulling & maintenance of cables.

- IP Based EPABX System comprising of 4 Nos. PRI Trunks lines (30 channels) with CLI facility for 100 IP users license for life time core switches, L2 switches, OFC and all accessories includes installation of minimum 100 nos. IP Digital phones and 300 nos. analog telephone with CLI facility complete with extendable IP EPBAX system having software license for minimum 500 connections.

F. FIRE ALARM SYSTEM WITH INTEGRATED VOICE EVACUATION AND TELEPHONE TALK BACK SYSTEM

A. An intelligent reporting, microprocessor controlled fire detection system shall be installed for Hospital block in accordance to the technical specifications.

B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Class X Signaling Line Circuits (SLC).
2. Device Circuits (IDC) shall be wired NFPA, Class X as part of an addressable device connected by the SLC Circuit.
3. Notification Appliance Circuits (NAC) shall be wired NFPA, Class X as part of an addressable device connected by the SLC Circuit.
4. On Class X configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

6. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.
7. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone whichever is greater.
8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
9. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.

Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.

Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.

Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.
10. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B, or two Class A circuits.
11. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:
 - a. The digital amplifier shall automatically broadcast the stored audio message.
 - b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.
 - c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.
 - d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to **Ten (10)** remote Fire Fighter's Telephone locations simultaneously on a conference in multiple FFT Risers.
 - e. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.
 - f. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of up to 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 350 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.
12. The proposed product shall not restrict the buyer to one single organization, nor shall it require any proprietary dongle or other programming tools for after sales & maintenance activity.
13. Fire Survival armoured cable shall be used as per NBC-2016/ relevant IS codes.

G. IP BASED CLOSED CIRCUIT TELEVISION SYSTEM (CCTV SYSTEM)

The CCTV and Surveillance System shall control and monitor different buildings in the Campus. All the buildings shall have IP Based Dome Cameras, Bullet Cameras and PTZ Cameras for surveillance. The types of cameras & locations of various Cameras indicated herein are minimum to be provided.

Hospital Block – Dome Cameras (Indoor/Outdoor Type) + PTZ Cameras on pole or Roof top (Outdoor)

The indoor Dome Cameras and Bullet Cameras are proposed to be installed at all Entry & Exit Points, main corridor, Lift lobbies & common areas like staircases, internal corridors, Waiting areas, reception, nursing stations of Hospital.

All the outdoor cameras shall be in IP-67 Housing with Junction box, media converter etc. is proposed in weather proof housing. The existing LAN network switches would be used for CCTV connectivity and will be connected to central CCTV server & cameras shall have POE connectivity ports.

Network connectivity for outdoor cameras having distance more than 80 metres, shall be on optical fiber. Suitable provision shall be provided to connect with existing LAN infrastructure. The power supply to LAN switches and Monitors will be on UPS. The video recording shall be Network Video Management System with Storage -64/32 Channel NVR with RAID supported.

Bullet/Dome camera:-These cameras shall be as per detail specification with IR suitable for Day and night operations. All the cameras shall be operative on automotive manual & scheduled mode. The cameras shall be UL Listed. RJ- 45 Cable connectors will be used for Network/POE connectivity.

1. **PTZ outdoor cameras:** - The true IP day and night viewing PTZ cameras proposed are 30 x optical zoom, P-iris with minimum 2 MP resolution & Auto focus lens with focal length 4.5 mm to 135 mm or better. The PTZ camera shall automatically track the object to use its Pan/Tilt/Zoom feature and primary stream at 60/50 frames per sec. The cameras shall be UL Listed. RJ- 45 Cable connectors will be used for Network/ POE connectivity.
2. **Network Video Management System:** -The IP Video Management Storage Appliance shall be a RAID 5 protected all-in-one recording, viewing and management solution for network surveillance systems of up to 64 cameras in 1080p HD resolution. The IP Video Management Storage Appliance shall utilize "enterprise-rated" hard drives. Shall offer/support upto 8 Sata 64 TB of net capacity storage for each 32/64 Channels. The IP Video Management Storage Appliance shall offer Dual Hard disk protected with RAID 1 on 2x 240GB M.2SSD. Installation of an IP based Camera CCTV system with the objective to provide High degree of Electronic surveillance system. It is also essential to have recorded images to be stored at least for 30 days @ 2MP 30fps of all critical are as to facilitate investigations of a reported case. System should be offered with 30 days of Storage @ 2MP 30fps in RAID-5 with 20% Buffer capacity
3. **VIDEO WALL:-** The sufficient no. of (2x2) Video wall Panel to be provided for viewing all live/ recorded camera proceedings. Total diagonal size of 110" VIDEO WALL Ultra HD LED Display for Monitoring Multifaceted UHD video wall solution based on daisy chain through the use of Display Port, Ultra-narrow 3.5mm bezel-to-bezel. Anti-glare panel (haze 44%), with reliable 24/7 operation.

Control Room shall be located in the Hospital block. The wiring inside the building shall be with CAT 6A cable in conduit and for Outdoor connectivity Armored fiber Optic Cable shall be used. Optical fiber cable shall be laid underground in HDPE pipes with suitable Manholes for easy pulling and proper Maintenance. PTZ cameras will be placed on roof top and on Street light Poles with necessary mounting arrangements in external areas.

H. ACCESS CONTROL SYSTEM:

Access Control system will be magnetic door type controlled through Card readers in all sensitive areas like OT's/ICUs Corridor, Laboratory, All Stores, OPD Departments, critical equipment rooms in Main Hospital. Block. Server rooms and data centers shall be provided access control through Biometric with card system. IP based door controllers and other devices as per technical specifications shall be provided as required. Existing LAN infrastructure shall be used for network connectivity of IP based door controllers. Each Controller will control maximum of four doors which can be for single or double leaf door. Both side of doors for entry and exit readers has to be provided along with the emergency break glass switch, to be used In case of emergency. The centralized control will be managed through a server to be installed in main Security Control/ Server Room. For Overriding purpose Push Button will be provided inside the rooms.

The system will be capable to record the biometric attendance and access control data with Card of the authorized personnel and the records will be stored in server. Access control software should support unlimited client workstation without restriction on limit of number of users. Biometric attendance machines with Card have to be provided in each block of Hospital building at the staff entry door. It is suggested that the attendance system would be Aadhaar Enable Biometric.

I. Hospital Management Information System:

For HMIS, required wire/cable network with copper cables/ CAT-6A/Optical fiber cable shall only be provided. As HMIS is user specific tool, Software/Hardware for HMIS shall be separately dealt by AGIHF.

J. MATV SYSTEM

The system shall include supply and installation of Centralized MATV System in various areas of Hospital as per marked in GFC drawings. The system comprises of a shared coaxial cable network that transmits analog television signals to downstream subscribers.

LED Monitors shall be provided in common reception/waiting areas, Hospital, Cafeteria, medical superintendent's chamber, etc. or as directed by Engineer-In-Charge.

LED monitors shall be provided in Private wards etc. or as directed by Engineer-In-Charge. MATV system shall be interconnected with Information Display system.

The Master antenna/Dish shall be provided at Hospital Terrace. It shall be provided at the top most convenient point in the building with a suitable room at convenient location for housing the amplifier & other equipment etc.

From the amplifier rooms, MS conduits should be laid in recess to facilitate drawing coaxial cable to individual areas. Suitable Tap Off boxes shall be provided as per requirement.

The specifications of the same are listed below:

- a) **Conduiting-** Conduiting for MATV system shall be carried out in M.S. Conduit.
- b) **Outlets** - All MATV outlets shall be provided with modular range of cover plate, box and coaxial outlet. Cover plate shall match in shape & finish with other light and power accessories.
- c) **Junction Box:** Suitable size of GI box shall be provided for termination of conduit for MATV system.
- d) **MATV Line Amplifiers:** The MATV Amplifier shall be housed in high frequency resistant aluminum housing at the highest level (terrace level). The MATV Amplifier shall have an in built variable equalizer and Alternator for site signal condition adjustments.
- e) **Coaxial Cables:** The coaxial cable shall be of wideband type.
- f) **Tap Off/ Splitter:** These shall be of ultra-wide bandwidth and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have

aluminum cast housing for high frequency radiation resistance. The Tap offs shall be in one way, two way and four way configurations.

K. UPS:

UPS units suitable for 3-phase power supply shall be provided. Suitable capacity of Centralized UPS shall be installed for computers points, Laboratory equipment, LV system, Operation theatres, and other essential loads as required in the Hospital, however X-ray, CT scan, PAT Scan & MRI etc. shall have their own UPS system built in with Medical Equipment. The UPS shall be Modular Fault Tolerant Redundant Double conversion type and shall provide a regulated and uninterrupted three-phase AC power, within specified tolerances, to critical station loads during normal and emergency operations with latest 3 Level **IGBT Inverter Technology** with External isolation transformer at UPS input to be provided for uninterrupted power supply for all Emergency requirements. UPS with separate Power distribution system (comprising of distribution panels, rising mains, distribution boards etc.) shall be provided for each block. The UPS System shall have minimum efficiency of 95 % or higher.

The UPS power Supply shall be with **isolation transformers for Hospital**. The UPS System shall be for **30 Min** Backup with Maintenance Free batteries and Bypass system. The system shall have the incoming and outgoing switchgear panel. The system shall include the interconnection of UPS Input/output power supply Panels & UPS units, UPS & Batteries through flexible copper cables of suitable size. UPS shall be equipped with communication card for data monitoring on IBMS System.

Proposed minimum UPS capacity shall be as follows:

UPS Selection for Operation Theatre				
Floor	Description	Connected Load (kW)	Diversity	Demand Load (kW)
Ground Floor	Minor Treatment Room OT - (2 Nos. @ 8 kW each)	16.0	1.0	16.0
First Floor	Major OT's - (9 Nos. @ 10 kW each)	90.0	1.0	90.0
	Cath lab OT (1 No. @ 10 kW each)	10.0	0.8	8.0
Second Floor	Gynae OT - (1 No. @ 10 kW each)	10.0	1.0	10.0
	Total	126.0 kW		124.0 kW
	kVA required 0.9 Power Factor	137.8 KVA		
	kVA required @ 90 % loading on UPS	153.1 KVA		
	UPS Proposed	1 Nos. 150 kVA, (N + N Configuration) 30 minute battery backup		

UPS Selection for Small Medical Equipment, Beds & Office Equipment				
S. No.	Description	Connected Load (kW)	Diversity	Demand Load (kW)
1	Small Medical Equipment	72.1	0.4	28.8
2	IPD/ OPD/ OT/ PRE-OT BEDS (ASSUMED)	164.1	0.5	82.1
3	Server Equipment (Assumed)	50.0	1	50.0
4	Workstation, Printer, Photocopier & other IT Load (Assumed)	54.0	0.8	43.2

5	Emergency Lighting Load @ 10%	36.3	1	36.3
	Total	376.5 kW		240.4 kW
	kVA required 0.9 Power Factor	267.1 KVA		
	kVA required @ 90 % loading on UPS	296.8 KVA		
	UPS Proposed	1 No. 300 kVA (N + 1 Configuration) 30 minute battery backup		

UPS Selection for Elevators (Only for Hospital)				
S. No.	Description	Connected Load (kW)	Diversity	Demand Load (kW)
1	Lifts - 16 Nos. @ 16 kW each (In Hospital Block, 16 lifts are used)	256	0.7	179.2
	Total	256 kW		179 kW
	kVA required 0.9 Power Factor	199.1 KVA		
	kVA required @ 90 % loading on UPS	221.2 KVA		
	UPS Proposed	2 No. 120 kVA, (N + 1 Configuration) 30 minute battery backup		

L. OT ISOLATION PANEL:

Each Operation Theatre will have its own dedicated Medical Isolation Power Supply panel. Medical Isolation Panel shall have single-phase isolating transformer according to IEC 60364-7-710 and NEC SP30: 2023 with a maximum rated power of 10 KVA according to IEC 61558-2-15 and have secondary voltage of AC 250 V and a maximum transformer secondary leakage current of 0.5 mA to earth as per IEC 60364-7-710. The secondary circuit shall be ungrounded (IT) system. The isolation transformer shall be provided with overload and over-temperature monitoring alarm through PTC thermistors. A visual alarm shall be issued when the permissible load current and/or temperature are exceeded.

An insulation monitoring device (in accordance with IEC 61557-8) shall be provided at the secondary ungrounded side of the isolation transformer to indicate the occurrence of a first fault from live part to exposed-conductive-parts or to earth.

It should have high level of fault discrimination and to increase power availability, 12 numbers of load feeder with 230 VAC DP MCB protection (with 20A max with breaking capacity 10KA) shall be used (wall outlets or surgical/ anaesthesia pendants).

It shall have capability to integrate seamlessly with BMS/ Surgeon Control Panel.

All the operating room electrical cabinets shall be wired and physically organized in the same way.

M. SOLAR PHOTOVOLTAIC POWER SYSTEM:

Grid interactive Solar Photo Voltaic Power system of suitable capacity shall be provided. The generated power will be directly connected to the Power grid/Distribution Panel of respective Building/ Block for load sharing during day time. The average area requirement per kWp will be 10 sq. Mtr on roof Top. The total Capacity of Solar Power System to be provided shall be **50 kWp**.

N. LIFT WORK :

The EPC Contractor shall carry out, Engineering, Supply, Installation, and Testing & Commissioning of Lift Works. Passenger cum Bed lifts, Passenger Lifts etc. shall be provided for Hospital building as per approved architectural drawings. The installation shall be carried out as per rules & regulation of local bodies and IS Codes that governs the requirement of installation of the lift. The voltage and frequency of the supply shall subject to variation permissible under Indian Electricity Act and Rules. Passenger cum Bed lifts and Passenger Lifts for AAHII at IIT Campus shall be provided as per NBC 2016 norms.

IP-based CCTV camera (1 No.) shall be provided in all Lift Cars of all buildings for surveillance/monitoring of lift control panel. The CCTV cameras, installed in the lifts, shall be connected/ integrated with the CCTV system with suitable cabling, hardware items etc. as required. Suitable warning mentioning "You are under CCTV surveillance" shall be posted inside the lift car. These cameras may be located at ceiling level and at any location which cannot be easily accessed, noticed or tampered with. The cable used for connecting in car camera to monitoring system, shall be of trailing grade. Ordinary co-axial or twisted pair wires shall not be lashed or tied along with trailing cables. Specialized trailing cables shall be used in lift applications. Wireless CCTV cameras complete with transmitter/ receiver & all accessories as required, may also be provided alternatively.

Emergency Rescues Devices along with dedicated UPS, power cabling, switchgear and all accessories for shall be provided individually for each lift by EPC Contractor with 15 minutes battery backup as per ASSAM Govt. Gazette Notification No. PEL.96/2001/PTI.1/06 dt 22.12.2010 – The Assam Lifts and Escalators (Amendment) Bill 2010.

S.No.	DESCRIPTION OF LIFT	UNITS	SHAFT SIZE	CAPACITY	HEIGHT	STOPS
A.	HOSPITAL BLOCK					
TOWER 1	ATTENDENTS LIFT	2	1800 X 3000	15 / 16 PAX	G+6	7
	SERVICE LIFT	1	2150 X 3000	1000 KG	G+6	7
	PATIENT LIFT (Future) 1 no		2400 X 3000		G+7	8
TOWER 2	PATIENT LIFT	6	2150 X 3000	15 / 16 PAX	G+6	7
	PATIENT LIFT	1	2400 X 3000		G+6	7
	SERVICE LIFT	1	2150 X 3000	1000 KG	G+6	7
TOWER 3	STAFF LIFT	2	2150 X 3000	15 / 16 PAX	G+6	7
	PATIENT LIFT	1	2150 X 3000	15 / 16 PAX	G+3	4
	LIFT IN FUTURE (STAFF) (Future) 1 No		2150 X 3000	15 / 16 PAX	G+6	7
	TOTAL	14				

Note:

1. Passenger Cum Bed Lift Speed for building height upto G+6 : 1.0 mtr./sec.
2. All Passenger Lift Speed for building height upto G+6 : 1.5 mtr./sec.
3. All 15/16 Passenger cum Bed Lifts in Hospital Building shall have Two Panel Telescopic Doors (2P TSPD) with door opening width of 1100 mm clear.

4. Lift Well, Car Size, Lift Pit Depth, Overhead, and Clear Entrance Width & Height dimensions shall conform to NBC 2016 or OEM Standards/ recommendations. All lifts shall be Gearless Type with Machine room & Centre Opening.
5. Lift Car enclosure & doors shall be made out of SS 304 sheet of 1.5 mm thickness.
6. Flooring: 20 mm recess for Granite/ Marble Stone flooring of approved quality and shade in the scope of manufacturer, color to be decided by Architect/ Client.
7. All lift shall have necessary provisions & door opening as required for physically challenged person.
8. Power supply to each Lift Panel shall be connected with dual source. One elevator from each bank of elevators shall be key operated to be used as fireman's lift as per code.
9. Lift Car operating Panel shall be equipped with Braille buttons. Automatic rescue device and emergency lighting shall be provided in each elevator supported by independent rechargeable batteries.
10. Lifts shall be complete in all respect as per technical specifications and directions of Engineer-in-Charge.

SCOPE OF WORK AND BRIEF DESCRIPTION OF ELECTRICAL WORKS (R&D Building)

ELECTRICAL SYSTEM

Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Rising mains, Cables, Cable Trays, Ducts, etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cutouts, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.

All Services as required like electrical power, telephone points, LAN/Data points, UPS points, raw/ soft/ etc. shall be adequately provided by the EPC Contractor.

General Services in the scope of Electrical Work (R&D Building)

The services to be provided by Contractor shall include following services.

- Electrical installations & fans including all electrical fittings/fixtures, raising main & cables for normal supply, generator supply, UPS supply, signages, signboards as necessary (as per GFC drawings and Technical Specification).
- SITC of Lightning protection and Earthing system (as per GFC drawings and Technical Specification).
- SITC of UPS back up as per requirements supported by calculations & GFC drawings/ Technical Specification.
- SITC of Lifts (as per GFC drawings and Technical Specification/Lift Schedule).
- SITC of Audio visual system in conference halls, meeting rooms & lecture halls (180 Pax & 70 Pax) as per GFC drawings and Particular Specification.
- SITC of LAN & IP based EPABX system (as per GFC drawings and Technical Specification).
- SITC of IP based CCTV system complete with PTZ, Fixed bullet and dome cameras, NVR, LED panels, control system, software, hardware etc. (as per GFC drawings and Technical Specification)
- SITC of Automatic Fire Detection/Alarm and Evacuation system (as per GFC drawings and Technical Specification).
- SITC of Solar PV generation (as per GFC drawings and Technical Specification).
- Contractor can claim the extra cost against power points if total quantity of power points increases beyond 20%.

O. INTERNAL ELECTRIFICATION, LV & ALLIED WORKS:

Following works shall be carried out in coordination with the civil work within the buildings complete in all respects strictly as per CPWD Specifications latest up to date, latest IS Codes, NBC -2016.

- Wiring & Conduiting PVC Conduits for internal electrification, LV & Allied works.
- Fire Survival Cable shall be used for Fire Alarm system.
- Ceiling fans & wall fans are not required however if required or as directed by Engineer-in-charge contractor shall provide the same without any extra cost.
- 6A Light Point/UPS Modular Switch & Socket Outlets (Anti Bacteria).
- 16A/ 20A Power/UPS Modular Switch & Socket Outlets
- L.T. Cables and Sub main wiring, circuit wiring.
- Cable Tray.
- Rising Mains & End Feed Units.
- Main Distribution panels for light, power, AHU's, Lift, Ventilation, UPS panel at all floor.

- Distribution Boards & VTPN DBs.
- Earthing & Lighting Protection system.
- Extra Low Voltage system like Telephone, IPBAX, LAN & Wi-Fi, Fire Detection & Alarm including Evacuation System, CCTV System, Access control system etc.

Following points shall be generally followed for internal and external electrification of various areas:

- Internal areas like rooms, corridors, lobbies, staircases, terraces, washrooms etc. of all buildings and blocks shall be adequately illuminated conforming to provisions stipulated in NBC 2016, ECBC and CPWD technical specifications maintaining the indicated Lux levels and Light Power Density.
- The Internal Electrification work shall be carried out in recessed/surface mounted PVC conduits only in accordance with CPWD General Specifications for Electrical Works Part-I (Internal)-2023 and Part-II (External)-2023 with up to date amendments.
- PVC Conduits shall be surface mounted or laid on MS angle/channels with suitable hanging supports in areas wherever there is false ceiling provision. In case there is no provision for false ceiling, PVC Conduits shall be concealed in concrete during slab casting. Wiring for lighting/power, & LV work wiring shall be done in PVC Conduits.
- FRLS PVC insulated Copper conductor wires will be used for points, circuit wiring conforming to relevant IS-Codes.
- Agency shall execute the work after obtaining necessary approval of the layout for internal electrification of Hospital, common areas and staircases etc. The staircase lighting shall be in group control system.
- Modular type switches (Anti Bacteria), sockets and stepped type electronic fan regulators, bell push button along with matching mounting boxes of same make shall be used.
- Colour coding of the conduits, switches, sockets shall be provided for Normal & UPS power supply as per NBC 2016.
- LED Type Lighting fixtures shall be provided as per Lighting Schedule.
- Self-sufficient battery operated emergency lighting to be provided in corridor & common areas only.
- Ceiling fans & wall fans are not required however if required or as directed by Engineer-in-charge contractor shall provide the same without any extra cost.
- Separate shafts shall be provided for laying of pipes for Electrical, ELV, Mechanical and Fire Services.
- After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2023 & Indian Electricity Rules 2005 amendment upto date, shall be recorded and submitted. The results shall be within the permissible limits.
- Suitable illumination with LED light fixture shall be provided on terraces as per lighting Schedule and GFC drawings.
- Power Points, LAN points, UPS power point, Telephone Point (with telephone instrument as required) shall be provided for all counters like registration, reception, nurse call station etc.
- Lighting Fixture shall be provided as per GFC drawings and lighting schedule.

P. LIGHTING DESIGN & LIGHTING FIXTURE

LED lighting fixtures shall be provided with inbuilt Harmonic suppression system in all areas as to achieve the illumination levels conforming to latest IS Code, NBC 2016, ECBC latest up to date and as per Technical Specifications. All LED lighting Fixture shall have luminous efficacy of more than 120 Lumens per watt. Lighting Power Density (LPD) shall be as per lighting simulation requirements.

Q. COMPUTER/ LAN NETWORKING/ WI-FI POINTS

Foiled shield CAT6 ACABLES & COMPONENTS, FIBER OPTICS CABLE & COMPONENTS

- The Supplying, installation, testing and commissioning of FOILED SHIELD CAT6A data cables shall include supply and laying of cables in PVC conduit on ceiling/ wall/ slab etc.

Cat 6A RJ 45 data outlets points will be provided for Computers, Networking, Telephones, Wi-Fi, Access Control, CCTV, Information Display system, BMS etc. as per requirement in rooms and other areas as drawings provided. To protect Cat 6A outlets from authorized/unauthorized insertion of cords or foreign objects and/or deter unintended or unauthorized disconnection of cords, Outlet adapter lock and secure patch cord solution to be used which utilizes universal keys to provide secure and tamper proof connections.

The Data Outlet points shall be connected to Rack Panel/Computer hub with 4 pair CAT-6A wiring in recessed/ surface PVC conduit as required. UPS Power supply shall be provided to Network Rack, Servers & Computers wherever required.

The maximum length of the CAT-6A cable from end user point to the Hub or Edge switches shall not be more than 90 M. Beyond 90 M length Fiber Optic Cable shall be used.

The Rack Panel/computer hub at various floors will be connected to Main rack of the block with Fiber Optic Cable through PVC conduit on surface/ recess.

The Rack Panel comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, Trans-receivers, Fiber patch cord etc. of individual floor floors.

LAN Infrastructure at different Floors shall be used commonly for IPABX, BMS, Access Control System, CCTV etc. along with LAN.

Color coding management: Different color I/O will be provided for the different services at I/O and Rack end to identify the all services by color. Patch cord should be with different color interchangeable rings on the patch cord to identify different services and this should help avoiding to manage the stock of multiple patch cords for maintenance purpose.

Field terminated plugs made for CAT-6A will be used for any device to be installed in ceiling (For Ex-Camera, WI-FI, etc.) for improved performance and more efficient power deliveries by eliminating extra connection points for patch cords and outlets. Cat6A cable and field terminated plug should be of same make for system performance guarantee by the OEM.

Wireless access points for Wi-Fi connectivity are proposed in entire building however, Common area, waiting area are to be provided with Wi-Fi connectivity, whereas other work station area in the building shall be with wired data outlets along with the Wi-Fi connectivity.

LAN system shall comprise of minimum 125 nodes and having appropriate quantity of access point for covering the complete R&D building. It also includes necessary backbone active and passive infrastructure like Cat 6A cable, Fibre Optic cable, networking L-2 & L3 switches, patch panels, patch cords, NMS, Access points for wi-fi, controllers etc. as per the Tender specifications and GFC drawings.

Note:

- **Voice and Data Communication System May share same back bone IT infrastructure.**
- **Server & Software part are not in contractor scope.**

R. FIRE ALARM SYSTEM WITH INTEGRATED VOICE EVACUATION AND TELEPHONE TALK BACK SYSTEM

- A. An intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the technical specifications.
- B. Basic Performance:
1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Class X Signaling Line Circuits (SLC).
 2. Device Circuits (IDC) shall be wired NFPA, Class X as part of an addressable device connected by the SLC Circuit.
 3. Notification Appliance Circuits (NAC) shall be wired NFPA, Class X as part of an addressable device connected by the SLC Circuit.
 4. On Class X configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
 6. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.
 7. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone whichever is greater.
 8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
 9. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.
Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.
Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.
Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.
 10. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B, or two Class A circuits.
 11. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of

supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:

- a. The digital amplifier shall automatically broadcast the stored audio message.
 - b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.
 - c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.
 - d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to **Ten (10)** remote Fire Fighter's Telephone locations simultaneously on a conference in multiple FFT Risers.
 - e. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.
 - f. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of up to 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 350 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.
12. The proposed product shall not restrict the buyer to one single organization, nor shall it require any proprietary dongle or other programming tools for after sales & maintenance activity.
13. Fire Survival shall be used. Fire Survival armoured cable shall be used as per NBC-2016/ relevant IS codes.

S. IP BASED CLOSED CIRCUIT TELEVISION SYSTEM (CCTV SYSTEM)

The CCTV and Surveillance System shall control and monitor different buildings in the Campus. All the buildings shall have IP Based Dome Cameras, Bullet Cameras and PTZ Cameras for surveillance. The types of cameras & locations of various Cameras indicated herein are minimum to be provided.

Dome Cameras (Indoor/Outdoor Type) + PTZ Cameras on pole or Roof top (Outdoor)

The indoor Dome Cameras and Bullet Cameras are proposed to be installed at all Entry & Exit Points, main corridor, Lift lobbies & common areas like staircases, internal corridors, Waiting areas, reception.

All the outdoor cameras shall be in IP-67 Housing with Junction box, media converter etc. is proposed in weather proof housing. The existing LAN network switchches would be used for CCTV connectivity and will be connected to central CCTV server & cameras shall have POE connectivity ports.

Network connectivity for outdoor cameras having distance more than 80 metres, shall be on optical fiber. Suitable provision shall be provided to connect with existing LAN infrastructure. The power supply to LAN switches and Monitors will be on UPS. The video recording shall be Network Video Management System with Storage -64/32 Channel NVR with RAID supported.

Bullet/Dome camera:-These cameras shall be as per detail specification with IR suitable for Day and night operations. All the cameras shall be operative on automotive manual &

scheduled mode. The cameras shall be UL Listed. RJ- 45 Cable connectors will be used for Network/POE connectivity.

4. **PTZ outdoor cameras:** - The true IP day and night viewing PTZ cameras proposed are 30 x optical zoom, P-iris with minimum 2 MP resolution & Auto focus lens with focal length 4.5 mm to 135 mm or better. The PTZ camera shall automatically track the object to use its Pan/Tilt/Zoom feature and primary stream at 60/50 frames per sec. The cameras shall be UL Listed. RJ- 45 Cable connectors will be used for Network/ POE connectivity.
5. **Network Video Management System:** -The IP Video Management Storage Appliance shall be a RAID 5 protected all-in-one recording, viewing and management solution for network surveillance systems of up to 64 cameras in 1080p HD resolution. The IP Video Management Storage Appliance shall utilize "enterprise-rated" hard drives. Shall offer/support upto 8 Sata 64 TB of net capacity storage for each 32/64 Channels. The IP Video Management Storage Appliance shall offer Dual Hard disk protected with RAID 1 on 2x 240GB M.2SSD. Installation of an IP based Camera CCTV system with the objective to provide High degree of Electronic surveillance system. It is also essential to have recorded images to be stored at least for 30 days @ 2MP 30fps of all critical are as to facilitate investigations of a reported case. System should be offered with 30 days of Storage @ 2MP 30fps in RAID-5 with 20% Buffer capacity

Control Room shall be located in the Hospital block. The wiring inside the building shall be with CAT 6A cable in conduit and for Outdoor connectivity Armored fiber Optic Cable shall be used. Optical fiber cable shall be laid underground in HDPE pipes with suitable Manholes for easy pulling and proper Maintenance. PTZ cameras will be placed on roof top and on Street light Poles with necessary mounting arrangements in external areas.

T. UPS:

UPS units suitable for 3-phase power supply shall be provided. Suitable capacity of Centralized UPS shall be installed for computers points, Laboratory equipment, LV system etc. shall have their own UPS system built in with Medical Equipment. The UPS shall be Modular Fault Tolerant Redundant Double conversion type and shall provide a regulated and uninterrupted three-phase AC power, within specified tolerances, to critical station loads during normal and emergency operations with latest 3 Level **IGBT Inverter Technology** with External isolation transformer at UPS input to be provided for uninterrupted power supply for all Emergency requirements. UPS with separate Power distribution system (comprising of distribution panels, rising mains, distribution boards etc.) shall be provided for each block. The UPS System shall have minimum efficiency of 95 % or higher.

The UPS power Supply shall be with **isolation transformers for R&D Building**. The UPS System shall be for **30 Min** Backup with Maintenance Free batteries and Bypass system. The system shall have the incoming and outgoing switchgear panel. The system shall include the interconnection of UPS Input/output power supply Panels & UPS units, UPS & Batteries through flexible copper cables of suitable size. UPS shall be equipped with communication card for data monitoring on IBMS System.

Proposed minimum UPS capacity shall be as follows:

UPS Selection for R&D Block and Academic Block				
S. No.	Description	Connected Load (kW)	Diversity	Demand Load (kW)

1	UPS MDB	64.4	0.8	51.5
	Total	64.4 kW		51.5 kW
	kVA required 0.9 Power Factor	57.2 KVA		
	kVA required @ 90 % loading on UPS	63.6 KVA		
	UPS Proposed	1 No. 100 kVA, (N + 1 Configuration) 30 minute battery backup		

U. LIFT WORK :

The EPC Contractor shall carry out, Engineering, Supply, Installation, and Testing & Commissioning of Lift Works. Passenger Lifts shall be provided for building as per approved architectural drawings. The installation shall be carried out as per rules & regulation of local bodies and IS Codes that governs the requirement of installation of the lift. The voltage and frequency of the supply shall subject to variation permissible under Indian Electricity Act and Rules. Passenger Lifts for AAHII at IIT Campus shall be provided as per NBC 2016 norms.

IP-based CCTV camera (1 No.) shall be provided in all Lift Cars of all buildings for surveillance/monitoring of lift control panel. The CCTV cameras, installed in the lifts, shall be connected/ integrated with the CCTV system with suitable cabling, hardware items etc. as required. Suitable warning mentioning "You are under CCTV surveillance" shall be posted inside the lift car. These cameras may be located at ceiling level and at any location which cannot be easily accessed, noticed or tampered with. The cable used for connecting in car camera to monitoring system, shall be of trailing grade. Ordinary co-axial or twisted pair wires shall not be lashed or tied along with trailing cables. Specialized trailing cables shall be used in lift applications. Wireless CCTV cameras complete with transmitter/ receiver & all accessories as required, may also be provided alternatively.

Emergency Rescues Devices along with dedicated UPS, power cabling, switchgear and all accessories for shall be provided individually for each lift by EPC Contractor with 15 minutes battery backup as per ASSAM Govt. Gazette Notification No. PEL.96/2001/PTI.1/06 dt 22.12.2010 – The Assam Lifts and Escalators (Amendment) Bill 2010.

S.No.	DESCRIPTION OF LIFT	UNITS	SHAFT SIZE	CAPACITY	HEIGHT	STOPS
B.	R&D and ACADEMIC BLOCK					
1.	PASSENGER LIFT	1	2150 X 3000	15 / 16 PAX	G+4	5
2.	PASSENGER LIFT (Future) 3 nos		2150 X 3000	15 / 16 PAX	G+4	5
3.	PASSENGER LIFT (Staff Side)	2	2150 X 2400	8 TO 10 PAX	G+4	5
	TOTAL	3				

Note:

1. All Passenger Lift Speed for building height upto G+4 : 1.0 mtr./sec.

2. Lift Well, Car Size, Lift Pit Depth, Overhead, and Clear Entrance Width & Height dimensions shall conform to NBC 2016 or OEM Standards/ recommendations. All lifts shall be Gearless Type with Machine room & Centre Opening.
 3. Lift Car enclosure & doors shall be made out of SS 304 sheet of 1.5 mm thickness.
 4. Flooring: 20 mm recess for Granite/ Marble Stone flooring of approved quality and shade in the scope of manufacturer, color to be decided by Architect/ Client.
 5. All lift shall have necessary provisions & door opening as required for physically challenged person.
 6. Power supply to each Lift Panel shall be connected with dual source. One elevator from each bank of elevators shall be key operated to be used as fireman's lift as per code.
 7. Lift Car operating Panel shall be equipped with Braille buttons. Automatic rescue device and emergency lighting shall be provided in each elevator supported by independent rechargeable batteries.
 8. Necessary space as per relevant CPWD specifications amended up to date shall be provided in the architecture drawing for these lifts. Lifts shall be complete in all respect as per technical specifications and directions of Engineer-in Charge.
-

SCOPE OF WORK AND BRIEF DESCRIPTION OF ELECTRICAL WORKS (Guest House cum Residential Hostel Building)

ELECTRICAL SYSTEM

Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Rising mains, Cables, Cable Trays, Ducts, etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cutouts, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.

All Services as required like electrical power, telephone points, LAN/Data points, UPS points, raw/ soft/ etc. shall be adequately provided by the EPC Contractor.

General Services in the scope of Electrical Work (Guest House cum Residential Hostel Building)

The services to be provided by Contractor shall include following services.

- Electrical installations & fans including all electrical fittings/fixtures, cables for normal supply, generator supply, signages, signboards as necessary (as per GFC drawings and Technical Specification).
- SITC of Lightning protection and Earthing system (as per GFC drawings and Technical Specification).
- SITC of Lifts (as per GFC drawings and Technical Specification/Lift Schedule).
- SITC of LAN & IP based Telephone system for guest house & telephone & Wi-Fi system for hostel (as per GFC drawings and Technical Specification).
- SITC of IP based CCTV system complete with PTZ, Fixed bullet and dome cameras, NVR, LED panels, control system, software, hardware etc. (as per GFC drawings and Technical Specification)
- SITC of manual Fire Alarm and evacuation saystem (as per GFC drawings and Technical Specification).

V. INTERNAL ELECTRIFICATION, LV & ALLIED WORKS:

Following works shall be carried out in coordination with the civil work within the buildings complete in all respects strictly as per CPWD Specifications latest up to date, latest IS Codes, NBC -2016.

- Wiring & Conduiting PVC Conduit for internal electrification, LV & Allied works.
- Fire Survival Cable shall be used for Fire Alarm system.
- LED Light fixtures (As per Lighting Schedule), Fan (Ceiling & Wall) & Exhaust Fans.
- 6A Light Point/UPS Modular Switch & Key Tag for Guest Rooms & Socket Outlets.
- 16A/ 20A Power/UPS Modular Switch & Socket Outlets
- L.T. Cables and Sub main wiring, circuit wiring.
- Cable Tray.
- Distribution Boards & VTPN DBs.
- Main Distribution panels for light, power, VRF/VRV system, Lift, Ventilation, UPS panel at all floor.
- Earthing & Lighting Protection system.
- Extra Low Voltage system like Telephone, IPBAX, LAN & Wi-Fi, Fire Alarm System, CCTV System, MATV etc.

Following points shall be generally followed for internal and external electrification of various areas:

- a. Internal areas like rooms, corridors, lobbies, staircases, terraces, washrooms etc. of all buildings and blocks shall be adequately illuminated conforming to provisions stipulated in NBC 2016, ECBC and CPWD technical specifications maintaining the indicated Lux levels and Light Power Density.
- b. The Internal Electrification work shall be carried out in recessed/surface mounted Heavy Duty PVC Conduits only in accordance with CPWD General Specifications for Electrical Works Part-I (Internal)-2023 and Part-II (External)-2023 with up to date amendments.
- c. Heavy Duty PVC Conduits shall be surface mounted or laid on MS angle/channels with suitable hanging supports in areas wherever there is false ceiling provision. In case there is no provision for false ceiling, Heavy Duty PVC Conduits shall be concealed in

concrete during slab casting. Wiring for lighting/power, & LV work wiring shall be done in Heavy Duty PVC Conduits.

- d. FRLS PVC insulated Copper conductor wires will be used for points, circuit wiring conforming to relevant IS-Codes.
- e. Agency shall execute the work after obtaining necessary approval of the layout for internal electrification etc. The staircase lighting shall be in group control system.
- f. Modular type switches, sockets and stepped type electronic fan regulators, bell push button along with matching mounting boxes of same make shall be used.
- g. Colour coding of the conduits, switches, sockets shall be provided for Normal & UPS power supply as per NBC **2016**.
- h. TV outlet point wiring shall be terminated in suitable size of G.I. box along with splitter at every floor or as per requirement. The interconnections of all splitter boxes fixed at all floors shall be done properly with conduits to form proper distribution system with the prior approval of Engineer-in-charge.
- i. LED Type Lighting fixtures shall be provided as per Lighting Schedule.
- j. Self-sufficient battery operated emergency lighting to be provided in corridor & common areas only.
- k. Suitable size & capacity Ceiling Fans/ Wall Fans shall be provided in all areas as required and as directed by Engineer-in-Charge.
- l. Separate shafts shall be provided for laying of pipes for Electrical, ELV, Mechanical and Fire Services.
- m. After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2023 & Indian Electricity Rules 2005 amendment upto date, shall be recorded and submitted. The results shall be within the permissible limits.
- n. Suitable illumination with LED light fixture shall be provided on terraces as per lighting Schedule.
- o. Power Points, LAN points, UPS power point, Telephone Point (with telephone instrument as required) shall be provided for all counters like registration, reception, nurse call station etc.

W. LIGHTING DESIGN & LIGHTING FIXTURE

LED lighting fixtures shall be provided with inbuilt Harmonic suppression system in all areas as to achieve the illumination levels conforming to latest IS Code, NBC 2016, ECBC latest up to date and as per Technical Specifications. All LED lighting Fixture shall have luminous efficacy of more than 120 Lumens per watt. Lighting Power Density (LPD) shall be as per lighting simulation requirements.

X. COMPUTER/ LAN NETWORKING/ WI-FI POINTS

Foiled shield CAT6 ACABLES & COMPONENTS, FIBER OPTICS CABLE & COMPONENTS

The Supplying, installation, testing and commissioning of FOILED SHIELD CAT6A data cables shall include supply and laying of cables in PVC conduit on ceiling/ wall/ slab etc..

Cat 6A RJ 45 data outlets points will be provided for Computers, Networking, Telephones, Wi-Fi, Access Control, CCTV, Information Display system, BMS etc. as per requirement in rooms and other areas as drawings provided. To protect Cat 6A outlets from authorized/unauthorized insertion of cords or foreign objects and/or deter unintended or unauthorized disconnection of cords, Outlet adapter lock and secure patch cord solution to be used which utilizes universal keys to provide secure and tamper proof connections.

The Data Outlet points shall be connected to Rack Panel/Computer hub with 4 pair CAT-6A wiring in recessed/ surface PVC conduit as required. UPS Power supply shall be provided to Network Rack, Servers & Computers wherever required.

The maximum length of the CAT-6A cable from end user point to the Hub or Edge switches shall not be more than 90 M. Beyond 90 M length Fiber Optic Cable shall be used.

The Rack Panel/computer hub at various floors will be connected to Main rack of the block with Fiber Optic Cable through PVC conduit on surface/ recess.

The Rack Panel comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, Trans-receivers, Fiber patch cord etc. of individual floor floors.

LAN Infrastructure at different Floors shall be used commonly for IPABX, BMS, Access Control System, CCTV etc. along with LAN.

Color coding management: Different color I/O will be provided for the different services at I/O and Rack end to identify the all services by color. Patch cord should be with different color interchangeable rings on the patch cord to identify different services and this should help avoiding to manage the stock of multiple patch cords for maintenance purpose.

Field terminated plugs made for CAT-6A will be used for any device to be installed in ceiling (For Ex-Camera, WI-FI, etc.) for improved performance and more efficient power deliveries by eliminating extra connection points for patch cords and outlets. Cat6A cable and field terminated plug should be of same make for system performance guarantee by the OEM.

Wireless access points for Wi-Fi connectivity are proposed in entire building however, Common area, waiting area are to be provided with Wi-Fi connectivity, whereas other work station area in the building shall be with wired data outlets along with the Wi-Fi connectivity.

LAN system shall comprise of minimum 80 nodes and having appropriate quantity of access point for covering the complete building. It also includes necessary backbone active and passive infrastructure like Cat 6A cable, Fibre Optic cable, networking L-2 & L3 switches, patch panels, patch cords, NMS, Access points for wi-fi, controllers etc. as per the Tender specifications and GFC drawings.

Note:

- **Voice and Data Communication System May share same back bone IT infrastructure.**
- **Server & Software part are not in contractor scope.**

Y. IP BASED CLOSED CIRCUIT TELEVISION SYSTEM (CCTV SYSTEM)

The CCTV and Surveillance System shall control and monitor different buildings in the Campus. All the buildings shall have IP Based Dome Cameras, Bullet Cameras and PTZ Cameras for surveillance. The types of cameras & locations of various Cameras indicated herein are minimum to be provided.

Dome Cameras (Indoor/Outdoor Type) + PTZ Cameras on pole or Roof top (Outdoor)

The indoor Dome Cameras and Bullet Cameras are proposed to be installed at all Entry & Exit Points, main corridor, Lift lobbies & common areas like staircases, internal corridors, Waiting areas, reception.

All the outdoor cameras shall be in IP-67 Housing with Junction box, media converter etc. is proposed in weather proof housing. The existing LAN network switch.

ches would be used for CCTV connectivity and will be connected to central CCTV server & cameras shall have POE connectivity ports.

Network connectivity for outdoor cameras having distance more than 80 metres, shall be on optical fiber. Suitable provision shall be provided to connect with existing LAN infrastructure. The power supply to LAN switches and Monitors will be on UPS. The video recording shall be Network Video Management System with Storage -64/32 Channel NVR with RAID supported.

Bullet/Dome camera:-These cameras shall be as per detail specification with IR suitable for Day and night operations. All the cameras shall be operative on automotive manual & scheduled mode. The cameras shall be UL Listed. RJ- 45 Cable connectors will be used for Network/POE connectivity.

6. **PTZ outdoor cameras:** - The true IP day and night viewing PTZ cameras proposed are 30 x optical zoom, P-iris with minimum 2 MP resolution & Auto focus lens with focal length 4.5 mm to 135 mm or better. The PTZ camera shall automatically track the object to use its Pan/Tilt/Zoom feature and primary stream at 60/50 frames per sec. The cameras shall be UL Listed. RJ- 45 Cable connectors will be used for Network/ POE connectivity.

7. **Network Video Management System:** -The IP Video Management Storage Appliance shall be a RAID 5 protected all-in-one recording, viewing and management solution for network surveillance systems of up to 64 cameras in 1080p HD resolution. The IP Video Management Storage Appliance shall utilize "enterprise-rated" hard drives. Shall offer/ support upto 8 Sata 64 TB of net capacity storage for each 32/64 Channels. The IP Video Management Storage Appliance shall offer Dual Hard disk protected with RAID 1 on 2x 240GB M.2SSD. Installation of an IP based Camera CCTV system with the objective to provide High degree of Electronic surveillance system. It is also essential to have recorded images to be stored at least for 30 days @ 2MP 30fps of all critical are as to facilitate investigations of a reported case. System should be offered with 30 days of Storage @ 2MP 30fps in RAID-5 with 20% Buffer capacity

Z. **MATV SYSTEM**

The system shall include supply and installation of Centralized MATV System in various areas of Hostel & Guest House as directed by Engineer-In-Charge & as per marked in drawings. The system comprises of a shared coaxial cable network that transmits analog television signals to downstream subscribers.

LED Monitors shall be provided in common reception/waiting areas etc. or as directed by Engineer-In-Charge.

LED monitors shall be provided in Guest Rooms & Common Room etc. or as directed by Engineer-In-Charge.

The Master antenna/Dish shall be provided at Hospital Terrace. It shall be provided at the top most convenient point in the building with a suitable room at convenient location for housing the amplifier & other equipment etc.

From the amplifier rooms, PVC Conduits should be laid in recess to facilitate drawing coaxial cable to individual areas. Suitable Tap Off boxes shall be provided as per requirement.

The specifications of the same are listed below:

- g) **Conduiting-** Conduiting for MATV system shall be carried out in PVC Conduit.
- h) **Outlets** - All MATV outlets shall be provided with modular range of cover plate, box and coaxial outlet. Cover plate shall match in shape & finish with other light and power accessories.
- i) **Junction Box:** Suitable size of GI box shall be provided for termination of conduit for MATV system.

- j) **MATV Line Amplifiers:** The MATV Amplifier shall be housed in high frequency resistant aluminum housing at the highest level (terrace level). The MATV Amplifier shall have an in built variable equalizer and Alternator for site signal condition adjustments.
- k) **Coaxial Cables:** The coaxial cable shall be of wideband type.
- l) **Tap Off/ Splitter:** These shall be of ultra-wide bandwidth and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have aluminum cast housing for high frequency radiation resistance. The Tap offs shall be in one way, two way and four way configurations.

AA. LIFT WORK :

The EPC Contractor shall carry out, Engineering, Supply, Installation, and Testing & Commissioning of Lift Works. Passenger Lifts shall be provided for building as per approved architectural drawings. The installation shall be carried out as per rules & regulation of local bodies and IS Codes that governs the requirement of installation of the lift. The voltage and frequency of the supply shall subject to variation permissible under Indian Electricity Act and Rules. Passenger Lifts for AAHII at IIT Campus shall be provided as per NBC 2016 norms.

IP-based CCTV camera (1 No.) shall be provided in all Lift Cars of all buildings for surveillance/monitoring of lift control panel. The CCTV cameras, installed in the lifts, shall be connected/ integrated with the CCTV system with suitable cabling, hardware items etc. as required. Suitable warning mentioning "You are under CCTV surveillance" shall be posted inside the lift car. These cameras may be located at ceiling level and at any location which cannot be easily accessed, noticed or tampered with. The cable used for connecting in car camera to monitoring system, shall be of trailing grade. Ordinary co-axial or twisted pair wires shall not be lashed or tied along with trailing cables. Specialized trailing cables shall be used in lift applications. Wireless CCTV cameras complete with transmitter/ receiver & all accessories as required, may also be provided alternatively.

Emergency Rescues Devices along with dedicated UPS, power cabling, switchgear and all accessories for shall be provided individually for each lift by EPC Contractor with 15 minutes battery backup as per ASSAM Govt. Gazette Notification No. PEL.96/2001/PTI.1/06 dt 22.12.2010 – The Assam Lifts and Escalators (Amendment) Bill 2010.

S.No	DESCRIPTION OF LIFT	UNIT S	SHAFT SIZE	CAPACITY	HEIGHT	STOPS
E.	GUEST HOUSE + RESIDENT HOSTEL					
1.	PASSENGER LIFT	1	2150 X 2950	15 PAX	G+6	7
2.	PASSENGER LIFT	1	1900 X 2150	8 TO 10 PAX	G+6	7
3.	PASSENGER LIFT- (Future) 1 no		1900 X 2150	8 TO 10 PAX	G+6	7
	TOTAL	2				

Note:

1. All Passenger Lift Speed for building height upto G+6 : 1.0 mtr./sec.

2. Lift Well, Car Size, Lift Pit Depth, Overhead, and Clear Entrance Width & Height dimensions shall conform to NBC 2016 or OEM Standards/ recommendations. All lifts shall be Gearless Type with Machine room & Centre Opening.
3. Lift Car enclosure & doors shall be made out of SS 304 sheet of 1.5 mm thickness.
4. Flooring: 20 mm recess for Granite/ Marble Stone flooring of approved quality and shade in the scope of manufacturer, color to be decided by Architect/ Client.
5. All lift shall have necessary provisions & door opening as required for physically challenged person.
6. Power supply to each Lift Panel shall be connected with dual source. One elevator from each bank of elevators shall be key operated to be used as fireman's lift as per code.
7. Lift Car operating Panel shall be equipped with Braille buttons. Automatic rescue device and emergency lighting shall be provided in each elevator supported by independent rechargeable batteries.
8. Necessary space as per relevant CPWD specifications amended up to date shall be provided in the architecture drawing for these lifts.
9. Lifts shall be complete in all respect as per technical specifications and directions of Engineer-in-Charge.

SCOPE OF WORK AND BRIEF DESCRIPTION OF ELECTRICAL WORKS (2BHK, 3BHK & Nursing Hostel Building)

ELECTRICAL SYSTEM

Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Rising mains, Cables, Cable Trays, Ducts, etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cutouts, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.

All Services as required like electrical power, telephone points, LAN/Data points, UPS points, raw/ soft/ etc. shall be adequately provided by the EPC Contractor.

General Services in the scope of Electrical Work

The services to be provided by Contractor shall include following services.

- Electrical installations & fans including all electrical fittings/fixtures, cables for normal supply, generator supply, signages, signboards as necessary (as per GFC drawings and Technical Specification).
- SITC of Lightning protection and Earthing system (as per GFC drawings and Technical Specification).
- SITC of Lifts (as per GFC drawings and Technical Specification/Lift Schedule).
- SITC of IP based CCTV system complete with PTZ, Fixed bullet and dome cameras, NVR, LED panels, control system, software, hardware etc. (as per GFC drawings and Technical Specification)
- SITC of manual Fire Detection/Alarm and Evacuation system (as per GFC drawings and Technical Specification).

BB. INTERNAL ELECTRIFICATION, LV & ALLIED WORKS:

Following works shall be carried out in coordination with the civil work within the buildings complete in all respects strictly as per CPWD Specifications latest up to date, latest IS Codes, NBC -2016.

- Wiring & Conduiting PVC Conduits for internal electrification, LV & Allied works.
- Fire Survival Cable shall be used for Manual Fire Alarm system (MCP & Hooter at staircase).
- LED Light fixtures (As per Lighting Schedule), Fan (Ceiling & Wall) & Exhaust Fans.
- 6A Light Point Modular Switch & Socket Outlets.
- 16A/ 20A Power Modular Switch & Socket Outlets
- L.T. Cables and Sub main wiring, circuit wiring.
- Cable Tray.
- Meter Board Panels, Distribution Boards & VTPN DBs.
- Earthing & Lighting Protection system.
- Extra Low Voltage system like Telephone, Wi-Fi, Fire Detection & Alarm System, CCTV System etc.
- Following points shall be generally followed for internal and external electrification of various areas:
 - Internal areas like rooms, corridors, lobbies, staircases, terraces, washrooms etc. of all buildings and blocks shall be adequately illuminated conforming to provisions stipulated in NBC 2016, ECBC and CPWD technical specifications maintaining the indicated Lux levels and Light Power Density.
 - The Internal Electrification work shall be carried out in recessed/surface mounted Heavy Duty PVC Conduits only in accordance with CPWD General Specifications for Electrical Works Part-I (Internal)-2023 and Part-II (External)-2023 with up to date amendments.
 - Heavy Duty PVC Conduits shall be surface mounted or laid on MS angle/channels with suitable hanging supports in areas wherever there is false ceiling provision. In case there is no provision for false ceiling, Heavy Duty PVC Conduits shall be concealed in concrete during slab casting. Wiring for lighting/power, & LV work wiring shall be done in Heavy Duty PVC Conduits.
 - FRLS PVC insulated Copper conductor wires will be used for points, circuit wiring conforming to relevant IS-Codes.
 - Agency shall execute the work after obtaining necessary approval of the layout for internal electrification etc. The staircase lighting shall be in group control system.
 - Modular type switches, sockets and stepped type electronic fan regulators, bell push button along with matching mounting boxes of same make shall be used.
 - Colour coding of the conduits, switches, sockets shall be provided for Normal power supply as per NBC 2016.
 - TV outlet point wiring shall be terminated in suitable size of G.I. box along with splitter at every floor or as per requirement. The interconnections of all splitter boxes fixed at all floors shall be done properly with conduits to form proper distribution system with the prior approval of Engineer-in-charge.
 - LED Type Lighting fixtures shall be provided as per Lighting Schedule.
 - Self-sufficient battery operated emergency lighting to be provided in corridor & common areas only.
 - Suitable size & capacity Ceiling Fans/ Wall Fans shall be provided in all areas as required and as directed by Engineer-in-Charge.
 - Separate shafts shall be provided for laying of pipes for Electrical, ELV, Mechanical and Fire Services.
 - After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2023 & Indian Electricity Rules 2005 amendment upto date, shall be recorded and submitted. The results shall be within the permissible limits.

- Suitable illumination with LED light fixture shall be provided on terraces as per lighting Schedule.
- Power Points, LAN points, UPS power point, Telephone Point (with telephone instrument as required) shall be provided for all counters like registration, reception, nurse call station etc.

CC. LIGHTING DESIGN & LIGHTING FIXTURE

LED lighting fixtures shall be provided with inbuilt Harmonic suppression system in all areas as to achieve the illumination levels conforming to latest IS Code, NBC 2016, ECBC latest up to date and as per Technical Specifications. All LED lighting Fixture shall have luminous efficacy of more than 120 Lumens per watt. Lighting Power Density (LPD) shall be as per lighting simulation requirements.

DD. IP BASED CLOSED CIRCUIT TELEVISION SYSTEM (CCTV SYSTEM)

The CCTV and Surveillance System shall control and monitor different buildings in the Campus. All the buildings shall have IP Based Dome Cameras, Bullet Cameras and PTZ Cameras for surveillance. The types of cameras & locations of various Cameras indicated herein are minimum to be provided.

Dome Cameras (Indoor)

The indoor Dome Cameras and Bullet Cameras are proposed to be installed at all Entry & Exit Points, main corridor, Lift lobbies & common areas like staircases, internal corridors, Waiting areas, reception.

Bullet/Dome camera:-These cameras shall be as per detail specification with IR suitable for Day and night operations. All the cameras shall be operative on automotive manual & scheduled mode. The cameras shall be UL Listed. RJ- 45 Cable connectors will be used for Network/POE connectivity.

Network Video Management System: -The IP Video Management Storage Appliance shall be a RAID 5 protected all-in-one recording, viewing and management solution for network surveillance systems of up to 64 cameras in 1080p HD resolution. The IP Video Management Storage Appliance shall utilize "enterprise-rated" hard drives. Shall offer/support upto 8 Sata 64 TB of net capacity storage for each 32/64 Channels. The IP Video Management Storage Appliance shall offer Dual Hard disk protected with RAID 1 on 2x 240GB M.2SSD. Installation of an IP based Camera CCTV system with the objective to provide High degree of Electronic surveillance system. It is also essential to have recorded images to be stored at least for 30 days @ 2MP 30fps of all critical are as to facilitate investigations of a reported case. System should be offered with 30 days of Storage @ 2MP 30fps in RAID-5 with 20% Buffer capacity

Control Room shall be located in the Hospital block. The wiring inside the building shall be with CAT 6A cable in conduit and for Outdoor connectivity Armored fiber Optic Cable shall be used. Optical fiber cable shall be laid underground in HDPE pipes with suitable Manholes for easy pulling and proper Maintenance. PTZ cameras will be placed on roof top and on Street light Poles with necessary mounting arrangements in external areas.

EE. LIFT WORK :

The EPC Contractor shall carry out, Engineering, Supply, Installation, and Testing & Commissioning of Lift Works. Passenger Lifts shall be provided for building as per approved architectural drawings. The installation shall be carried out as per rules & regulation of local bodies and IS Codes that governs the requirement of installation of the lift. The voltage and frequency of the supply shall subject to variation permissible under Indian Electricity Act and Rules. Passenger Lifts for AAHII at IIT Campus shall be provided as per NBC 2016 norms.

IP-based CCTV camera (1 No.) shall be provided in all Lift Cars of all buildings for surveillance/monitoring of lift control panel. The CCTV cameras, installed in the lifts, shall be connected/ integrated with the CCTV system with suitable cabling, hardware items etc. as required. Suitable warning mentioning "You are under CCTV surveillance" shall be posted inside the lift car. These cameras may be located at ceiling level and at any location which cannot be easily accessed, noticed or tampered with. The cable used for connecting in car camera to monitoring system, shall be of trailing grade. Ordinary co-axial or twisted pair wires shall not be lashed or tied along with trailing cables. Specialized trailing cables shall be used in lift applications. Wireless CCTV cameras complete with transmitter/ receiver & all accessories as required, may also be provided alternatively.

Emergency Rescues Devices along with dedicated UPS, power cabling, switchgear and all accessories for shall be provided individually for each lift by EPC Contractor with 15 minutes battery backup as per ASSAM Govt. Gazette Notification No. PEL.96/2001/PTI.1/06 dt 22.12.2010 – The Assam Lifts and Escalators (Amendment) Bill 2010.

S.No.	DESCRIPTION OF LIFT	UNITS	SHAFT SIZE	CAPACITY	HEIGHT	STOPS
C. 2BHK FACULTY TOWER						
1.	PASSENGER LIFT	1	2150 X 2950	15 PAX	G+6	7
2.	PASSENGER LIFT	1	1900 X 2150	8 TO 10 PAX	G+6	7
3.	PASSENGER LIFT (Future) 1 no		1900 X 2150	8 TO 10 PAX	G+6	7
TOTAL		2				

S.No.	DESCRIPTION OF LIFT	UNITS	SHAFT SIZE	CAPACITY	HEIGHT	STOPS
D. 3BHK FACULTY TOWER						
1.	PASSENGER LIFT	1	2150 X 2950	15 PAX	G+6	7
2.	PASSENGER LIFT	1	1900 X 2150	8 TO 10 PAX	G+6	7
TOTAL		2				

S.No.	DESCRIPTION OF LIFT	UNITS	SHAFT SIZE	CAPACITY	HEIGHT	STOPS
F. NURSE HOSTEL						
1.	PASSENGER LIFT	1	2150 X 2950	15 PAX	G+6	7
2.	PASSENGER LIFT	1	1900 X 2150	8 TO 10 PAX	G+6	7
TOTAL		2				

Note:

1. All Passenger Lift Speed for building height upto G+6 : 1.0 mtr./sec.
2. Lift Well, Car Size, Lift Pit Depth, Overhead, and Clear Entrance Width & Height dimensions shall conform to NBC 2016 or OEM Standards/ recommendations. All lifts shall be Gearless Type with Machine room & Centre Opening.
3. Lift Car enclosure & doors shall be made out of SS 304 sheet of 1.5 mm thickness.

4. Flooring: 20 mm recess for Granite/ Marble Stone flooring of approved quality and shade in the scope of manufacturer, color to be decided by Architect/ Client.
5. All lift shall have necessary provisions & door opening as required for physically challenged person.
6. Power supply to each Lift Panel shall be connected with dual source. One elevator from each bank of elevators shall be key operated to be used as fireman's lift as per code.
7. Lift Car operating Panel shall be equipped with Braille buttons. Automatic rescue device and emergency lighting shall be provided in each elevator supported by independent rechargeable batteries.
8. Necessary space as per relevant CPWD specifications amended up to date shall be provided in the architecture drawing for these lifts.
9. Lifts shall be complete in all respect as per technical specifications and directions of Engineer-in-Charge.

Note:

- The building will be designed and constructed as per GRIHA-3 norms for Hospital only).
- The responsibility of Investigations, Detailed Planning, Procurement, Construction, Safety, quality, and risk of Engineering lies with the contractor.
- Contractor shall be fully responsible for the execution, testing and commissioning.
- The Scope of work is to be read along with the GFC drawings, Particular specification etc. The contractor shall execute the E&M work as per scope of work, GFC drawing and Technical Specification, and special condition of contract.
- Contractor shall prepare DB (Distribution Board) details along with shop drawings and get approval from Engineer-In-Charge.
- Contractor shall prepare shops & coordinated drawings with respect to all MEP & Medical services drawings and got approved from Engineer-In-Charge before start of work.
- Laying of HDPE/Hume pipe, manhole, sleeves etc. for road crossing, entering in to the building shall be in contractor scope.
- The scope of the work of contract includes Quality Assurance Policy & Check List of E&M Services as per CPWD Hand book as amended upto date. Although major statutory approval shall be taken by the principal consultant however necessary support needed shall be provided by the contractor. The scope of work also includes three years defect liability period of all E&M services as mentioned above. LED fittings and fixture shall be with the warranty for five years from the date of completion and handing over the site to the client department. Warranty certificate/undertaking from the OEM shall be handed over to the owner by the contractor with name, contact number of the authorized person of OEM.
- The contractor shall make sample/mockup wherever necessary or as asked by the Engineer-In-Charge.
- All E&M services work shall be carried out as per relevant Indian standards/ IE rules/NBC-2016/specification covered in this contract/CPWD specification/ASHARE standards latest amended till date.
- Any up-gradation asked by the statutory department such as fire, EIA & APDCL etc. contractor has to do the same up-gradation as asked by authority without any extra cost.

- The power point shown in the GFC drawings may be changed during construction as per site requirement. There will be no extra cost paid against shifting of power points as per site requirement.
- Light number shown in extendable column is may be referred with respective light drawing for respective building.

**PARTICULAR SPECIFICATION FOR ELECTRICAL & LOW
VOLTAGE WORKS**

1. SCOPE OF WORK, USER REQUIREMENTS AND TECHNICAL SPECIFICATIONS:

GENERAL CONDITIONS FOR ALL E&M PACKAGES

1. The agency must study various CPWD specifications; get themselves acquainted with site and site conditions, provision for various system for the IIT Campus in local byelaws and additional conditions carefully. The work shall be executed in close co-ordination with the progress of building work.
2. The work shall be carried out in the following order of preference.
 - i. Indian electricity rules 2005 & Indian electricity act 2003 amended up to date.
 - ii. Additional Technical specifications and list of acceptable makes attached.
 - iii. CPWD general specifications for electrical works Part – I (Internal) – 2023 Part II (External) -2023 CPWD general specifications for electrical works Part – III (Lifts and Escalators) – 2003, CPWD general specifications for electrical works Part – IV (Sub stations) – 2013, Local Fire Regulations, CPWD general specifications for electrical works Part – V (Wet riser & sprinkler system) – 2020. CPWD general specifications for air-conditioning/ HVAC works – 2019, National Electrical Code 2023 amended up to date and Relevant sections of National building code 2016 and CPWD special publications available on CPWD website and Griha-3 star rating.

Note: - All electrical equipment shall be selected as per

Altitude: 49 meter above means sea level.

Ambient Temperature : 35.2 deg. C

RH 76.0%

- iv. (Note: The higher specifications/ stringent conditions of CPWD specifications/ NBC – 2016/ IEC amended till date, shall be followed).
 - v. Relevant BIS standards as modified up to date.
 - vi. Sound Engineering practice as approved by the Engineer – in – charge.
3. All the equipment shall be delivered with (i) Manufacturer’s test certificate, (ii) Manufacturer’s technical catalogues and Installation/ Instruction (O&M) manuals.
 4. Scaffoldings & any other T & P required for execution, testing and commissioning of work shall be arranged by the contractor and is included in the cost of work tendered by the contractor.
 5. The layout plans/ drawings/ other documents pertaining to E & M services shall have to be submitted for approval and got proof checked by an institute of repute as defined/ mentioned in the bid-document within the time period as specified in the table of mile stone.
 6. Inspection before Dispatch: All routine tests shall be conducted before dispatch of equipments. No equipment shall be dispatched out from the manufactures premises before such tests are conducted and test result recorded. These test certificates shall be given along the supply of equipments. The Engineer In-charge shall, if he so desires inspect and witness the pre-delivery tests. For this purpose, the agency shall give 15 day advance notice. Agency shall arrange for inspection of the department. Department shall bear expenses of its officials for inspection as far as traveling, boarding and/ lodging is concerned. However, the inspection shall be done at the discretion of the department without any cost implication but routine test & type test Certificates shall have to be submitted for equipments. Prior to dispatch, all equipments shall be adequately protected & insured for the whole period of transit, storage and erection against corrosion and incidental damages etc. from the effect of vermin, sunlight, rain, heat and humid climate.
- 7. PROCEDURE FOR APPROVAL OF MATERIALS, SHOP FLOOR DRAWINGS AND COMMENCEMENT OF WORK:**

Within the time specified in table of milestone the contractor shall submit following documents for approval.

- List of makes & Model numbers of all items of equipment and accessories each sub Head of work.
- Catalogues of the equipment to be supplied.
- Contractor shall submit the shop drawings of each package/ sub work separately for approval.

It is the responsibility of the tenderer to get the makes, models and shop floor drawings approved by the department before placing of order.

8. Insurance: The agency shall include storage cum erection insurance including third party insurance right from the storage to commissioning and handing over of various equipment. In insurance, the beneficiary shall be Engineer -In-charge at the cost of the agency. All insurance which the agency is required to enter into under the contract shall be affected any authorized general insurance company and the agency shall produce the policies of insurance. In case of any delay in ITC & handing over, the insurance cover will be suitably extended by the contractor at his own cost.
9. Remedy of failure to insure: If the agency fails to effect and keep in force the insurance referred to in the preceding sub-clause the department may affect and keep in force any such insurance and pay such premium as may be necessary for that purpose and from time to time deduct the amount, so paid by the department, from any money due or which may become due to bids or recover the same as debit from the agency's bill.
10. Quality of material and workmanship: All components of the equipments shall have adequate factor of safety. The work of fabrication and assembly shall conform to sound engineering practice and on the basis of "Fail Safe Design". The mechanical parts subject to wear and tear shall be easily replaceable type. The construction of the equipments shall be such as to facilitate easy operation, inspection, maintenance and repairs. All connections and contacts shall be designed to minimize risk of accidental short circuits caused by animals, birds and vermin etc. All identical items and their component parts should be completely, interchangeable including spare parts.
11. Inspection and testing at site :
 - i. The installation shall be subject to necessary inspection during every stage of erection, by the Engineer In-charge or his authorized representative. The successful bidder shall provide all facilities and assistance for the purpose.
 - ii. The completed installation shall be inspected and tested by the Engineer-in charge in the manner as will be laid down by him.
 - iii. All instruments and facilities necessary for the tests shall be provided by the Contractor.
12. Completeness of work :
 - (i) The installations shall be completed in all respects and put in to operation even where certain details have not been mentioned/ left out in these specifications. Any discrepancy may be brought out in pre-bid meeting.
 - (ii) All E&M services such as Internal Electrical installations, HVAC system, External lighting, pumping set etc. shall be declared as completed after completion of trial run of two season's summer and monsoon. However, maintenance of these installations during the maintenance period of 24 months shall be carried out by the agency at his own cost. DLP/ Warranty period of all works/ machine/ equipment shall commence from date of completion of complete work (project).
 - (iii) All electrical & mechanical fittings/ fixture/ appliances, to be provided for the work, where BEE certification is available should have 5-star rating (of BEE). Since, the proposed construction is for 3 star-GRIHA for hospital, all fittings and fixtures of minimum requirement required for the 3 star-GRIHA for hospital shall be provided.

The CPWD specifications are available at CPWD website "cpwd.gov.in". The department shall not be responsible for the lack of knowledge and also the consequences thereof to the Contractor. The information and data mentioned in the tender document have been furnished in good faith and for general information and guidance only.

13. INCIDENTAL CHARGES: All incidental charges of any kind including cartage, storage, wastage and safe custody of material etc. shall be borne by the Contractor.
14. QUALITY ASSURANCE: The Contractor shall make available, on request from the Department, for record, copies of challans, cash memos, receipts and other certificates, if any, vouchers towards the quantity and quality of various materials procured and the same shall be kept in record. These shall also provide information on the name of the manufacturer, manufacturer's product identification, manufacturer's instructions, warning, date of manufacturing and test certificates from manufacturers for the product for each consignment delivered at site, shelf life, if any, for the department to ensure that the material have been procured from the approved source and of the approved quality, as directed by the Engineer-in-Charge. Day to day account of receipt of such material shall be maintained at site of work and shall be regulated by the department. Nothing extra shall be payable on this account.
15. STORAGE OF MATERIALS: Storage and safe custody of all materials shall be the sole responsibility of the Contractor. Nothing extra shall be payable on this account. Storage space shall be the responsibility of Contractor.
- 16. QUALITY CONTROL AND TESTING OF MATERIALS:**
 - (i) All the material to be used on works shall bear ISI certification mark unless otherwise the make is specified in the item or special conditions appended this tender document. In case ISI mark material or the materials mentioned in the tender documents are not available, as per opinion of Engineer-in-charge, which shall be final and binding, the material to be used shall confirm to CPWD specifications applicable in this tender or IS Code. In such cases Engineer-in-charge shall satisfy himself about the quality or such material and give his approval in writing. Only articles classified as first quality by the manufacturers shall be used unless otherwise specified. All material not having ISI mark shall be tested as per relevant ISI specification. The Engineer in charge may relax the condition regarding testing if the quantity of the materials required for the work is small. In all cases of use of ISI marked materials proper proof of procurement of materials from authentic manufacturers shall be provided by the contractor to the entire satisfaction of Engineer-in-charge. All materials equivalent from approved make list to the one specified should be got approved by the Engineer-in-charge before using the said materials in the work.
 - (ii) If the department desires to send any samples of materials for testing in an accredited laboratory, the Contractor at his own expense shall supply all materials, labour for preparing and testing samples as required by the Engineer-in-Charge. The testing shall be carried out in the presence of the representative of the Engineer- in- Charge. The transportation and testing charges shall also be borne by the contractor.
17. No foreign exchange shall be made available by the department for importing (purchase) of equipment, plants, machinery, materials of any kind. No delay and no claim of any kind shall be entertained from the Contractor on account of variation in the foreign exchange rate and/ or any Custom duties/ charges or any other levies.
18. NO WAIVING OF LEGAL RIGHTS AND POWERS: The Engineer-in-Charge shall not be precluded or stopped from taking any measurements, and framing of estimates or detaining any certificates made either before or after the completion and acceptance of the work and payment, from showing the true amount and character of the works performed and materials Furnished by the Contractor and from showing that any such measurements, estimates or certificates untrue or incorrectly made and that Engineer-in-charge shall not be precluded or stopped from recovering from the Contractor such damages as it may be sustained by reasons of his failure to comply the terms and conditions of the contract.

19. The tenderers shall take into account the element of wastage(s) those are likely to be there in all elements of the work and quote his price, taking that into account. The tenderers shall study all the items from the point of view of wastage(s), which are likely to take place.
20. Power and water supply required for the construction, and testing & commissioning of equipment shall be arranged by the bidder at his own cost.
21. The description of E&M service & specification are given in general but they are not exhaustive i.e. does not mention all the incidental works required to be carried out for complete execution of the item of work. The work shall be carried out, all in accordance with true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and/ or described in the specifications, provided that the same can be reasonably inferred there from. There may be several incidental works, which are not mentioned in the contract document/specifications but will be necessary to complete the item in all respect. All these incidental works/ costs which are not mentioned, but are necessary to complete the work shall be deemed to have been included in the overall amount quoted by the contractor for various components of work. No adjustment of rates shall be made for any variation in quantum of incidental works due to variation/ change in actual working drawings. Also, no adjustment of rates shall be made due to any change in incidental works or any other deviation in such element of work (which is incidental to the items of work and are necessary to complete such items in all respects) on account of the directions of Engineer-in-charge. Nothing extra shall be payable on this account.
22. The scope of works also covers the preparation of layout plans, drawings for E & M schemes and approval of the same from the respective local bodies Fire Officer/Lift Inspector/ CFO etc. before the commencement of work. During execution, if the local bodies etc. require a modification, the same shall be executed out any extra cost. Finally, after execution, approvals/ NOCs/ clearances from local bodies etc. shall be the responsibility of successful bidder for which nothing extra is payable. In case any modification/ extra work is required by the local bodies necessary for approvals/ NOCs/ clearances, the same shall be get executed and nothing extra shall be paid on this account. All statutory fees/ charges required for obtaining clearances from Fire Officer/Lift Inspector/CEA/ Local Bodies shall be paid by the agency.

23. SUPERVISION OF WORK:

The Contractor shall depute Site Engineers & skilled workers as required for the work as per the documents required in technical bids. He shall submit organization chart along with details of Engineers and supervisory staff. It shall be ensured that all decision making powers shall be available to the representatives of the Contractor at IIT Campus, Guwahati itself to avoid any likely delays on this account. The Contractor shall also furnish list of persons for specialized works to be executed for various items of work. The Contractor shall identify and deploy key persons having qualifications and experience in the similar and other major works, as per the field of their expertise. If during the course of execution of work, the Engineer-in-Charge is of the opinion that the deployed staff is not sufficient or not well experienced; the Contractor shall deploy more staff or better-experienced staff at site to complete the work quality and in stipulated time limit.

2. SPECIFICATION FOR ELECTRICAL WORKS

1.0 GENERAL SCOPE OF WORK:

The specifications given below pertain to the internal electrical installation work to be carried out in Proposed AAHII at IIT Guwahati.

1. All internal electrical works shall be carried out with MS conduit in Hospital & rigid PVC conduit for other buildings. All switches, sockets, AC Starter, IP Phone socket, Data sockets, stepped type (2 module) fan regulators, bell push and accessories along with matching mounting boxes shall be of modular type.
2. Only antibacterial cover plates are to be used for switches, sockets, LAN outlets etc. in the hospital building.
3. All mounting boxes for plate type accessories shall be of metallic construction and of the same make as that of the plate type switches and accessories.
4. The wires used for the point wiring and power wiring shall be of 650/ 1100 Volts grade FRLS PVC insulated multi stranded copper conductor single core cables.
5. **All lighting fixtures should be LED as per lighting schedule and GFC drawing.**
6. Lightning should be carried out as per National Lighting Code 2010/NBC-2016/ECBC guidelines. Wherever range of illumination for space is mentioned, higher side of Lux level must be taken.
7. Arrangement of luminaries in various areas of buildings shall be done on the basis of National Lighting code 2010 and NBC 2016.
8. Ceiling fans will also be provided as per GFC drawings. Only 5star rated type ceiling fans of size 1400/ 1200 mm shall be used. Optimum size and number of ceiling fans for rooms of different size shall be as per provision laid down in CPWD specifications for internal E.I. work – 2023, and NBC 2016.
9. Wiring with Cat 6A for Intercom/ Telephone shall be terminated in suitable size of G.I. Junction box and RJ-45 socket. All the other end of wiring shall be terminated in Patch panel including rack of each floor and in the EPBAX room. The wiring shall be suitably tagged/mentioned mentioning the location of each point. The fiber optic cable shall be used for inter connection of networking switches. The patch panels patch chords and layer 2 and layer 3 switches are in scope of work.
10. Wiring with Cat 6A for LAN shall be terminated in suitable size of G.I. Junction box and RJ-45 socket. All the other end of wiring shall be terminated in Patch panel including rack of each block/floor and suitable wiring shall be done between all patch panels to server room. The fiber optic cable shall be used for inter connection of networking switches. The patch panels patch chords and layer 2 and layer 3 switches are in scope of work
11. Wiring for CCTV in MS conduit in hospital and rigid PVC conduit shall be provided as per the regulation and is to be terminated in G.I. Junction box.
12. VTPN DB shall be provided in R & D block or as required by Engineer in charge.
13. Details of the light fittings to be installed in different areas.

LIGHTING SCHEDULE (HOSPITAL BUILDING-IIT GUWAHATI)

S. No.	Areas	Light Legend as per Drawing	Fixture Type	Fixture Description
1	Staircase	L1	Surface Mounted Down light	<p>Supply of LED Surface mounted Downlighter having dia of 153mm(\pm 3mm) & height of 60mm(\pm 3mm) delivering minimum system lumen output of 2000 lumens and system wattage of 18W & with a minimum system efficacy of 110 lm/W. The luminaire should have a color temperature of 6500°K/4000K, CRI\geq80 and SDCM\leq5. The driver shall have THD\leq10% (@full Load) and PF \geq 0.95 (@full load). The luminaire housing should made of pressure die-cast aluminum. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, The fixture should comply with the parameters as per IS10322. The luminaire shall have impact resistance of IK02 & ingress protection of IP20. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire. Similar to above specs in Signify (Philips) Model No SM296C LED20S_Series/equivalent from approved make list from approved make list</p>

<p>2</p>	<p>Common Areas, Rooms etc.</p>	<p>L2</p>	<p>Recess Mounted Downlight</p>	<p>Supply of Recessed LED Downlighter made up of pressure die cast aluminum housing, Fixture should have minimum efficacy at System level (Not Chip Level) ≥ 110 lumens/watt with Minimum system Lumens 1500lm with maximum system wattage of 13.5W. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 6500K/4000K (SDCM<5), CRI >80, PF >0.95, IP20, working temp range - 0°C < Ta < 45°C, and operating Voltage Range of 240 VAC. It should has a Minimum Internal Surge Protection of 2.5KV. Electronic Switchable ballast. The fixture design should comply with EMC / EMI compliance along with BIS certification for LED Driver & Luminaire. Luminaire manufacture shall provide LM79 report from NABL accredited lab & LM80 report issued by LED manufacturer. Similar to above specs in Signify (Philips) Model No. DN296B LED15S_Series/ equivalent from approved make list from approved make list</p>
<p>3</p>	<p>AHU, Electrical Room. Service Room Etc.</p>	<p>L3</p>	<p>4FT, LED Batten Light 18W-2000lm, IP20</p>	<p>Supply of LED Batten in 18W, 2000 lm, 4ft Extruded aluminum housing fitted with engg. Plastic end plates. Easy fit profiles acrylic diffuser provides smooth light distribution. LED populated on PCB comprising of cool White LEDs connected in series parallel. CCT-6500K, THD<10%, driver efficacy>85%, surge protection 3KV, CRI>80, SDCM<5, power factor>0.95, efficacy 110lm/w. Driver: constant current output driver, operating range 140 – 270V AC supply voltages. The luminaire driver shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by</p>

				NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN170C LED20S_Series/ equivalent from approved make list from approved make list
4	Toilet Mirror Light	L4	2FT,LED Batten Light 11W-1200lm,IP20	Supply of LED Batten light of 2ft length with a system wattage of 10-11W with a nominal system lumen output of 1100-1200 lumens and a minimum system efficacy of 110lm/W. CCT shall be 4000K and CRI ≥ 80. Housing shall be extruded aluminium with powder coating & with IP20 protection. The luminaire shall meet IP20 rating with THD≤20% and PF ≥ 0.90.The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN021 LED12S_Series/ equivalent from approved make list from approved make list.
5	Entrance Lobby Triple Height Area	L5	Recessed COB Spot Light 30W-3000lm,Tiltabl e	Supply of recessed mounted 30W-3000lm Round Shape Adjustable spot light COB type, pressure die-cast aluminium heat sink in white powder coated finish with & clear glass, System lumen efficacy of 100 lm/W. Powered by electronic LED driver with Output Short-circuit protection, Surge protection 4KV, SDCM<5,THD<10%CRI >90, Color temperature 4000K/6500/3000K, IP20. Beam Angle of 36 D and Rotation Angle of 10-30 D.Dimensions: Cut out Dia-95mm,. Luminiare Insulation of Class I type and Serviceibility of class

				<p>Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs in Signify (Philips) RS262B LED30S_Series/ equivalent from approved make list from approved make list</p>
6	<p>Patient Area, Wards, office Area etc.</p>	L6	<p>Recessed 2'x2' Panel light with Prismatic diffuser 30W-3300lm</p>	<p>Supply of recessed mounted 2X2 LED panel ,made of CRCA housing with Prismatic Diffuser for low glare rating. LED Used shall be SMD type and fixture should have minimum efficacy at System level ≥ 110 lumens/watt with Minimum system Lumens 3300@30W, Life of fixture : 50000 burning Hrs. @ L70B50 Lumen maintenance,CCT-6500K, (SDCM≤ 5), CRI Ra ≥ 80, THD$< 10\%$, PF > 0.95, an operating Voltage Range of 140 - 270 VAC.Minimum Internal Surge Protection 4.0KV & IP20/IK02 protection, Fixture should comply with to IEC61000-3-2 ed.3.2, 2009 for Harmonics, IEC61347 -2 -13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, IEC62384 ed.1.1, 2011 for performance and IEC61547 ed.2.0, 2009, IEC 60598-2-2, CISPER 15 for EMC / EMI compliance with flicker free operations ripple $< 5\%$. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval.Similar to above specs in Signify (Philips) RC380B LED36S_Series/ equivalent from approved make list from approved make list</p>

7	Corridors, Consultation Room etc.	L7	<p>Recessed 2'x2' Panel light with PS diffuser 25W-3000lm</p>	<p>Supply of recessed mounted 2X2 LED panel ,made of CRCA housing with high efficiency PS Diffuser. LED Used shall be SMD type and fixture should have minimum efficacy at System level ≥ 120 lumens/watt with Minimum system Lumens 3000@25W, Life of fixture : 50000 burning Hrs. @ L70B50 Lumen maintenance,CCT-6500K, (SDCM≤ 5), CRI Ra ≥ 80, THD$< 10\%$, PF > 0.95, an operating Voltage Range of 140 - 270 VAC. Minimum Internal Surge Protection 4.0KV & IP20/IK02 protection, Fixture should comply with to IEC61000-3-2 ed.3.2, 2009 for Harmonics, IEC61347 -2 -13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, IEC62384 ed.1.1, 2011 for performance and IEC61547 ed.2.0, 2009, IEC 60598-2-2, CISPER 15 for EMC / EMI compliance with flicker free operations ripple $< 5\%$. Manufacturer shall have in-house lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs Signify (Philips) RC380B LED30S_Series/ equivalent from approved make list from approved make list</p>
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<p>8</p>	<p>Laboratory Area</p>	<p>L8</p>	<p>Recessed 2'x2' Cleanroom Panel light with IP65(from front) Ik07 protection 32W-3600lm</p>	<p>Supply of IP65 (from Front) recess mounted Cleanroom 2X2 LED panel ,made of CRCA housing with Acrylic cover with IK07 protection.Adjustable bracket mounting suitable for 40 to 100mm ceiling thickness (TO Cleanroom) LED Used shall be SMD type and fixture should have minimum efficacy at System level ≥ 110 lumens/watt with Minimum system Lumens 3600@32W, Life of fixture : 50000 burning Hrs. @ L70B50 Lumen maintenance,CCT-6500K, (SDCM≤ 5), CRI Ra ≥ 80, THD$< 10\%$, PF > 0.95, an operating Voltage Range of 140 - 270 VAC.Minimum Internal Surge Protection 4.0KV & IP65/IK07 protection, Fixture should comply with to IEC61000-3-2 ed.3.2, 2009 for Harmonics, IEC61347 -2 -13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, IEC62384 ed.1.1, 2011 for performance and IEC61547 ed.2.0, 2009, IEC 60598-2-2, CISPER 15 for EMC / EMI compliance with flicker free operations ripple $< 5\%$. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs in Signify (Philips) CR652B LED36S_Series/ equivalent from approved make list from approved make list.</p>
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<p>9</p>	<p>Conference Room, Board Room Etc.</p>	<p>L9</p>	<p>Low Glare UGR<16, Recessed 2x2 with pyramid led chambers for better aesthetics,3000lm 26W</p>	<p>Supply of LED Recessed mounted LED (2'x2') 595x595x70 mm fitting made of CRCA & sealed optical modules in shape of a pyramid or inverted cup made of Injection moulded polycarbonate/plastic/polystyrene/ABS Plastic. Each The luminaire shall employ deep recessed diffused optical compartments with individual diffuser for each optical module. The luminaire shall comply to UGR≤16. The luminaire shall have IK rating of IK-02. The luminaire should not have single flat diffuser for whole luminaire. The luminaire shall have System efficacy of ≥120lumens/watt. The luminaire shall deliver system lumen output of 3000 lumens. The LEDs used shall have CCT of 6500°K having CRI≥80, & SDCM≤5. The life shall be 50000 Burning hour at L70B50. and an operating Voltage Range of 140 - 270 Internal Surge Protection 2.5KV.The luminaire driver shall have THD≤ 10%, PF ≥0.95, internal surge protection of 2.5KV, operating voltage range of 140V - 270V. The luminaire shall have serviceability of Class B. The luminaire shall be IP20 compliant. The luminaire driver shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accredited lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) RC600B M LED30S_Series/ equivalent from approved make list from approved make list</p>
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<p>10</p>	<p>Main Entrance Lobby Corridor with Baffle Ceiling</p>	<p>L10</p>	<p>Suspended 4ft standalone, 50mm width Linear fixture,18.5W-2200lm</p>	<p>Supply of LED based suspended standalone 4ft. Luminaire with a nominal system lumen output of 2200@18.5W lumens with Downward light ratio and a minimum system efficacy of 120 lm/W. The LED driver shall be accessible without opening the LED compartment. The driver access shall be from the backside of the luminaire. The luminaire shall have a color temperature of 6500K and CRI≥80. The luminaire shall be made up of extruded aluminium and meet IP20 Rating with THD≤10% and PF≥0.9. The total Power Consumption should not exceed 20 W (including Driver). Dimensions :- 1120mm x 53mm x 70mm The luminaire driver shall be of the same make/manufacturer/brand as that of LED luminaires. The luminaire & driver shall have BIS registration & the bidder shall submit the BIS certificates along with technical BID. The LED luminaire manufacturer should have in-house NABL accredited lab to conduct type test, factory acceptance test before dispatch of material, LM79 test & IK test. The bidder shall submit the NABL accreditation of LED luminaire manufacturer along with technical bid. The bidder shall submit the Type test of luminaires & LM79 test reports issued by NABL accredited lab before supply of material. Similar to above specs in Signify (Philips) Model No- SP780H LED22S_Series/equivalent from approved make list from approved make list</p>
<p>11</p>	<p>Corridor Area</p>	<p>L11</p>	<p>Recessed Aluminum Channel with Strip Light-8W/Mtr-700lm</p>	<p>Supply of LED strip for mounting in Cove SDCM 3 between rolls, Color temperature 3000K, CRI≥80, 700 lumen/meter approx, efficacy >110lm/w, IP20, Lifetime 30K hours, working temperature -20°C to +35°C, supply voltage 24V DC. The bidder shall submit the NABL accreditation of LED luminaire manufacturer along with technical bid. The bidder shall submit the Type test of luminaires & LM79 test reports issued by NABL accredited lab before supply of material. Similar to above specs in Signify (Philips) Model No LS170S LED8_Series+Third party Driver 5+ 25-30 mm Aluminium channel + Diffuser/ equivalent from approved make list from approved make list</p>

<p>12</p>	<p>Entrance Lobby Triple Height Area</p>	<p>L12</p>	<p>Suspended Ring light in 600mm.900mm dia with wattage of 30W,60W,80W respectively</p>	<p>Supply of Suspended Architectural ring Light made up of Aluminium extruded profile and PS diffuser, LED used shall be SMD type with minimum System Efficacy of >80lm/W,CCT- 6500K/4000K, Wattage of 30W/60W/80W and minimum Lumen output of 2400lm,4800lm,6400lm. Respectively , Size option of 600mm,900mm and 1200mm respectively Ingress protection of IP20 Finish and Color Options as per requirement, Life L70B50 @ 50K Hrs.@ 45 Degree Ambient temp. Internal Surge protection of 4KV,THD <10%,CRI>80,SDCM<5, operating voltage range 140-270. Manufacturer shall have in-house lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs in Signify (Philips) Model No.SP682P_Series/ equivalent from approved make list from approved make list</p>
<p>13</p>	<p>Lift Shafts and Terrace</p>	<p>L13</p>	<p>Bulkhead Light-10W-1000lm</p>	<p>Supply of Endura Surface mounted LED Bulk head light made up of pressure Die Cast Housing, Wattage-10W,1000lm, ingress protection of IP65, CCT 4000K, CRI>80,SDCM<5 Life Span 50K hours @L70, THD<10%, PF>0.85. The luminaire shall be designed for operations under diverse environment from -10 deg C to 45 deg C, Input Voltage Range 140-270V, surge protection 2.5KV, high transmission PC diffuser. Dimensions: 180mm X 98mm X 79mm. The fixture should be BIS certified. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted.Similar to above specs in Signify (Philips)/ WT202W LED10S_Series/ equivalent from approved make list from approved make list</p>

14		L14		Supply of twin head 15W Emergency light fixture with Battery Backup following the Norms and Guidelines.
LIGHTING SCHEDULE (R&D Block-IIT GUWAHATI)				
S. No.	Areas	Light Legend as per Drawing	Fixture Type	Fixture Description
1	Staircase	L1	Surface Mounted Downlight	<p>Supply of LED Surface mounted Downlighter having dia of 153mm(± 3mm) & height of 60mm(± 3mm) delivering minimum system lumen output of 2000 lumens and system wattage of 18W & with a minimum system efficacy of 110 lm/W. The luminaire should have a color temperature of 6500°K/4000K, CRI≥80 and SDCM≤5. The driver shall have THD≤10% (@full Load) and PF ≥ 0.95 (@full load). The luminaire housing should be made of pressure die-cast aluminum. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, The fixture should comply with the parameters as per IS10322. The luminaire shall have impact resistance of IK02 & ingress protection of IP20. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accredited lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire. Similar to above specs in Signify (Philips) Model No SM296C LED20S_Series/ equivalent from approved make list from approved make list</p>

<p>2</p>	<p>Common Areas, Rooms etc.</p>	<p>L2</p>	<p>Recess Mounted Downlight</p>	<p>Supply of Recessed LED Downlighter made up of pressure die cast aluminum housing, Fixture should have minimum efficacy at System level (Not Chip Level) ≥ 110 lumens/watt with Minimum system Lumens 1500lm with maximum system wattage of 13.5W. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 6500K/4000K (SDCM<5), CRI >80, PF >0.95, IP20, working temp range - $0^{\circ}\text{C} < \text{Ta} < 45^{\circ}\text{C}$, and operating Voltage Range of 240 VAC. It should has a Minimum Internal Surge Protection of 2.5KV. Electronic Switchable ballast. The fixture design should comply with EMC / EMI compliance along with BIS certification for LED Driver & Luminaire. Luminaire manufacture shall provide LM79 report from NABL accredited lab & LM80 report issued by LED manufacturer. Similar to above specs in Signify (Philips) Model No. DN296B LED15S_Series/ equivalent from approved make list from approved make list</p>
<p>3</p>	<p>Lecture Theater Double Height Area</p>	<p>L3</p>	<p>Recessed COB Spot Light 20W-2000lm, Tilttable</p>	<p>Supply of recessed mounted 20W-2000lm Round Shape Adjustable spot light COB type, pressure die-cast aluminium heat sink in white powder coated finish with & clear glass, System lumen efficacy of 100 lm/W. Powered by electronic LED driver with Output Short-circuit protection, Surge protection 4KV, SDCM<5, THD$<10\%$ CRI >90, Color temperature 4000K/6500/3000K, IP20. Beam Angle of 36 D and Rotation Angle of 10-30 D. Dimensions: Cut out Dia-120mm,. Luminaire Insulation of Class I type and Serviceability of class B Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs in Signify (Philips) RS262B LED20S_Series/</p>

				equivalent from approved make list from approved make list
4	Double Height Common Area	L4	Suspended Cylindrical Down lighter 13.5W-1500lm	Supply of suspended/Surface mounted Cylindrical Downlight, 13.5W, 1500 lm, CCT 5700K, CRI>80, Efficacy ≥120lm/W, Surge 4Kv internal, THD ≤10% (At Full Load), Extruded aluminum housing, white/Black finish, Product Dia 100mm, Height 205mm, Life L70B50 @ 50K Hrs.@ 45 Degree Ambient temp. The product should be EMI/EMC compliant and ripple <5%. The product should have option of 24°, 36° and 60° beam angles to choose from as per the application. operating temperature should be -10° to +45°; operating volatereg range 140-270. The LED driver should comply to IEC61347 -2 -13, IEC62384 ed.1.1, 2011 for performance and IEC61547 ed.2.0, 2009. Manufacturer shall have in-house lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs in Signify (Philips) Model No. SP321P LED15S_Series/ equivalent from approved make list from approved make list
5	Dry Lab Areas	L5	Recessed 2'x2' Panel light with PS diffuer 30W-3600lm	Supply of recessed mounted 2X2 LED panel ,made of CRCA housing with high efficiency PS Diffuser. LED Used shall be SMD type and fixture should have minimum efficacy at System level >=120 lumens/watt with Minimum system Lumens 3600@30W, Life of fixture : 50000 burning Hrs. @ L70B50 Lumen maintenance,CCT-6500K, (SDCM<=5), CRI Ra >=80, THD<10%, PF >0.95, an operating Voltage Range of 140 - 270 VAC.Minimum Internal Surge Protection 4.0KV & IP20/IK02 protection, Fixture should comply with to IEC61000-3-2 ed.3.2, 2009 for Harmonics, IEC61347 -2 -13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, IEC62384 ed.1.1, 2011 for performance and

				IEC61547 ed.2.0, 2009, IEC 60598-2-2, CISPER 15 for EMC / EMI compliance with flicker free operations ripple <5%. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs in Signify (Philips) RC380B LED36S_Series/ equivalent from approved make list from approved make list
6	Toilet Mirror Light	L6	2FT,LED Batten Light 11W-1200lm,IP20	Supply of LED Batten light of 2ft length with a system wattage of 10-11W with a nominal system lumen output of 1100-1200 lumens and a minimum system efficacy of 110lm/W. CCT shall be 4000K and CRI ≥ 80. Housing shall be extruded aluminium with powder coating & with IP20 protection. The luminaire shall meet IP20 rating with THD≤20% and PF ≥ 0.90.The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN021 LED12S_Series/ equivalent from approved make list from approved make list

7	Lift Shafts and Terrace	L7	Bulkhead Light 10W-1000lm IP65	Supply of Endura Surface mounted LED Bulk head light made up of pressure Die Cast Housing, Wattage-10W,1000lm, ingress protection of IP65, CCT 4000K, CRI>80,SDCM<5 Life Span 50K hours @L70, THD<10%, PF>0.85. The luminaire shall be designed for operations under diverse environment from -10 deg C to 45 deg C, Input Voltage Range 140-270V, surge protection 2.5KV, high transmission PC diffuser. Dimensions: 180mm X 98mm X 79mm. The fixture should be BIS certified. Manufacturer shall have in-house lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted. Similar to above specs in Signify (Philips)/ WT202W LED10S_Series/ equivalent from approved make list from approved make list
8	AHU, Electrical Room. Service Room Etc.	L8,L9	4FT,LED Batten Light 18W-2000lm,IP20	Supply of LED Batten in 18W, 2000 lm, 4ft Extruded aluminum housing fitted with engg. Plastic end plates. Easy fit profiles acrylic diffuser provides smooth light distribution. LED populated on PCB comprising of cool White LEDs connected in series parallel. CCT-6500K, THD<10%, driver efficacy>85%, surge protection 3KV, CRI>80, SDCM<5, power factor>0.95, efficacy 110lm/w. Driver: constant current output driver, operating range 140 - 270V AC supply voltages. The luminaire driver shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test

				Certificate for luminaire as issued by NABL accredited lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN170C LED20S_Series/ equivalent from approved make list from approved make list.
9		L10		Supply of twin head 15W Emergency light fixture with Battery Backup following the Norms and Guidelines.

LIGHTING SCHEDULE (Guest House-IIT GUWAHATI)

S. No.	Areas	Light Legend as per Drawing	Fixture Type	Fixture Description
1	Guest House	L1	Recessed Mounted Downlight	Supply of Recessed LED Downlighter made up of pressure die cast aluminum housing, Fixture should have minimum efficacy at System level (Not Chip Level) ≥ 110 lumens/watt with Minimum system Lumens 1500lm with maximum system wattage of 13.5W. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 6500K/4000K (SDCM<5), CRI >80, PF >0.95, IP20, working temp range - 0°C < Ta < 45°C, and operating Voltage Range of 240 VAC. It should has a Minimum Internal Surge Protection of 2.5KV. Electronic Switchable ballast. The fixture design should comply with EMC / EMI compliance along with BIS certification for LED Driver & Luminaire. Luminaire manufacture shall provide LM79 report from NABL accredited lab & LM80 report issued by LED manufacturer. Similar to above specs in Signify (Philips) Model No. DN296B LED15S_Series/ equivalent from approved make list from approved make list

2	Guest House	L2	Recessed 2'x2' Panel light with PS diffuser 30W-3600lm	Supply of recessed mounted 2X2 LED panel ,made of CRCA housing with high efficiency PS Diffuser. LED Used shall be SMD type and fixture should have minimum efficacy at System level ≥ 120 lumens/watt with Minimum system Lumens 3600@30W, Life of fixture : 50000 burning Hrs. @ L70B50 Lumen maintenance,CCT-6500K, (SDCM ≤ 5), CRI Ra ≥ 80 , THD $< 10\%$, PF > 0.95 , an operating Voltage Range of 140 - 270 VAC.Minimum Internal Surge Protection 4.0KV & IP20/IK02 protection, Fixture should comply with to IEC61000-3-2 ed.3.2, 2009 for Harmonics, IEC61347 -2 -13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, IEC62384 ed.1.1, 2011 for performance and IEC61547 ed.2.0, 2009, IEC 60598-2-2, CISPER 15 for EMC / EMI compliance with flicker free operations ripple $< 5\%$. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs in Signify (Philips) RC380B LED36S_Series/ equivalent from approved make list from approved make list
3	Guest House	L3	2FT,LED Batten Light 11W-1200lm,IP20	Supply of LED Batten light of 2ft length with a system wattage of 10-11W with a nominal system lumen output of 1100-1200 lumens and a minimum system efficacy of 110lm/W. CCT shall be 4000K and CRI ≥ 80 . Housing shall be extruded aluminium with powder coating & with IP20 protection. The luminaire shall meet IP20 rating with THD $\leq 20\%$ and PF ≥ 0.90 .The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall

				submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN021 LED12S_Series/ equivalent from approved make list from approved make list
4	Guest House	L4	4FT,LED Batten Light 18W-2000lm,IP20	Supply of LED Batten in 18W, 2000 lm, 4ft Extruded aluminum housing fitted with engg. Plastic end plates. Easy fit profiles acrylic diffuser provides smooth light distribution. LED populated on PCB comprising of cool White LEDs connected in series parallel. CCT-6500K, THD<10%, driver efficacy>85%, surge protection 3KV, CRI>80, SDCM<5, power factor>0.95, efficacy 110lm/w. Driver: constant current output driver, operating range 140 – 270V AC supply voltages. The luminaire driver shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN170C LED20S_Series/ equivalent from approved make list from approved make list

5	Guest House	L5	Bulkhead Light 10W-1000lm IP65	Supply of Endura Surface mounted LED Bulk head light made up of pressure Die Cast Housing, Wattage-10W,1000lm, ingress protection of IP65, CCT 4000K, CRI>80,SDCM<5 Life Span 50K hours @L70, THD<10%, PF>0.85. The luminaire shall be designed for operations under diverse environment from -10 deg C to 45 deg C, Input Voltage Range 140-270V, surge protection 2.5KV, high transmission PC diffuser. Dimensions: 180mm X 98mm X 79mm. The fixture should be BIS certified. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted. Similar to above specs in Signify (Philips)/ WT202W LED10S_Series/ equivalent from approved make list from approved make list.
6	Guest House	L6	Emergency light with Battery BackUp	Supply of twin head 15W Emergency light fixture with Battery Backup following the Norms and Guidelines.

LIGHTING SCHEDULE (Nurse Hostel-IIT GUWAHATI)				
S. No.	Areas	Light Legend as per Drawing	Fixture Type	Fixture Description
1	Nurse hostel	L1	Surface Mounted Downlight	<p>Supply of LED Surface mounted Downlighter having dia of 153mm(± 3mm) & height of 60mm(± 3mm) delivering minimum system lumen output of 1500 lumens and system wattage of 13.5W & with a minimum system efficacy of 110 lm/W. The luminaire should have a color temperature of 6500°K/4000K, CRI≥80 and SDCM≤5. The driver shall have THD≤10% (@full Load) and PF ≥ 0.95 (@full load). The luminaire housing should made of pressure die-cast aluminum. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, The fixture should comply with the parameters as per IS10322. The luminaire shall have impact resistance of IK02 & ingress protection of IP20. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire. Similar to above specs in Signify (Philips) Model No SM296C LED15S_Series/ equivalent from approved make list from approved make list</p>

2	Nurse hostel	L2	Wall Bracket Light+E-27 Holder type LED bulb	Supply of Single head Wall Bracket light, Made up of Stainless steel base and Opal White painted Glass cover with E-27 Lamp base to fix E-27 Holder type bulb having wattage upto 20W, Similar to above specs in Signify (Philips) HDL Model No.58185+Philips E-27 18W holder LED bulb/ equivalent from approved make list from approved make list
3	Nurse hostel	L3	2FT,LED Batten Light 11W-1200lm,IP20	Supply of LED Batten light of 2ft length with a system wattage of 10-11W with a nominal system lumen output of 1100-1200 lumens and a minimum system efficacy of 110lm/W. CCT shall be 4000K and CRI ≥ 80. Housing shall be extruded aluminium with powder coating & with IP20 protection. The luminaire shall meet IP20 rating with THD≤20% and PF ≥ 0.90.The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN021 LED12S_Series/ equivalent from approved make list from approved make list

4	Nurse hostel	L4	4FT,LED Batten Light 18W-2000lm,IP20	<p>Supply of LED Batten in 18W, 2000 lm, 4ft Extruded aluminum housing fitted with engg. Plastic end plates. Easy fit profiles acrylic diffuser provides smooth light distribution. LED populated on PCB comprising of cool White LEDs connected in series parallel. CCT-6500K, THD<10%, driver efficacy>85%, surge protection 3KV, CRI>80, SDCM<5, power factor>0.95, efficacy 110lm/w. Driver: constant current output driver, operating range 140 – 270V AC supply voltages. The luminaire driver shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN170C LED20S_Series/ equivalent from approved make list from approved make list</p>
5	Nurse hostel	L5	Bulkhead Light 10W-1000lm IP65	<p>Supply of Endura Surface mounted LED Bulk head light made up of pressure Die Cast Housing, Wattage-10W,1000lm, ingress protection of IP65, CCT 4000K, CRI>80,SDCM<5 Life Span 50K hours @L70, THD<10%, PF>0.85. The luminaire shall be designed for operations under diverse environment from -10 deg C to 45 deg C, Input Voltage Range 140-270V, surge protection 2.5KV, high transmission PC diffuser. Dimensions: 180mm X 98mm X 79mm. The fixture should be BIS certified. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM</p>

				79 and LM80 reports need to be submitted. Similar to above specs in Signify (Philips)/ WT202W LED10S_Series/ equivalent from approved make list from approved make list.
6	Nurse hostel	L6	Emergency light with Battery BackUp	Supply of twin head 15W Emergency light fixture with Battery Backup following the Norms and Guidelines.
7	Nurse hostel	L7	Recessed 2'x2' Panel light with PS diffuser 30W-3600lm	Supply of recessed mounted 2X2 LED panel ,made of CRCA housing with high efficiency PS Diffuser. LED Used shall be SMD type and fixture should have minimum efficacy at System level ≥ 120 lumens/watt with Minimum system Lumens 3600@30W, Life of fixture : 50000 burning Hrs. @ L70B50 Lumen maintenance,CCT-6500K, (SDCM ≤ 5), CRI Ra ≥ 80 , THD $< 10\%$, PF > 0.95 , an operating Voltage Range of 140 - 270 VAC. Minimum Internal Surge Protection 4.0KV & IP20/IK02 protection, Fixture should comply with to IEC61000-3-2 ed.3.2, 2009 for Harmonics, IEC61347 -2 -13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, IEC62384 ed.1.1, 2011 for performance and IEC61547 ed.2.0, 2009, IEC 60598-2-2, CISPER 15 for EMC / EMI compliance with flicker free operations ripple $< 5\%$. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs in Signify (Philips) RC380B LED36S_Series/ equivalent from approved make list from approved make list.

LIGHTING SCHEDULE (2BHK-IIT GUWAHATI)				
S. No.	Areas	Light Legend as per Drawing	Fixture Type	Fixture Description
1	2BHK	L1	Surface Mounted Downlight	<p>Supply of LED Surface mounted Downlighter having dia of 153mm(\pm 3mm) & height of 60mm(\pm 3mm) delivering minimum system lumen output of 1500 lumens and system wattage of 13.5W & with a minimum system efficacy of 110 lm/W. The luminaire should have a color temperature of 6500°K/4000K, CRI\geq80 and SDCM\leq5. The driver shall have THD\leq10% (@full Load) and PF \geq 0.95 (@full load). The luminaire housing should made of pressure die-cast aluminum. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, The fixture should comply with the parameters as per IS10322. The luminaire shall have impact resistance of IK02 & ingress protection of IP20. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire. Similar to above specs in Signify (Philips) Model No SM296C LED15S_Series/ equivalent from approved make list from approved make list</p>

2	2BHK	L2	Wall Bracket Light+E-27 Holder type LED bulb	Supply of Single head Wall Bracket light, Made up of Stainless steel base and Opal White painted Glass cover with E-27 Lamp base to fix E-27 Holder type bulb having wattage upto 20W, Similar to above specs in Signify (Philips) HDL Model No.58185+Philips E-27 18W holder LED bulb/ equivalent from approved make list from approved make list
3	2BHK	L3	2FT,LED Batten Light 11W-1200lm,IP20	Supply of LED Batten light of 2ft length with a system wattage of 10-11W with a nominal system lumen output of 1100-1200 lumens and a minimum system efficacy of 110lm/W. CCT shall be 4000K and CRI ≥ 80. Housing shall be extruded aluminium with powder coating & with IP20 protection. The luminaire shall meet IP20 rating with THD≤20% and PF ≥ 0.90.The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN021 LED12S_Series/ equivalent from approved make list from approved make list

4	2BHK	L4	<p>4FT,LED Batten Light 18W-2000lm,IP20</p>	<p>Supply of LED Batten in 18W, 2000 lm, 4ft Extruded aluminum housing fitted with engg. Plastic end plates. Easy fit profiles acrylic diffuser provides smooth light distribution. LED populated on PCB comprising of cool White LEDs connected in series parallel. CCT-6500K, THD<10%, driver efficacy>85%, surge protection 3KV, CRI>80, SDCM<5, power factor>0.95, efficacy 110lm/w. Driver: constant current output driver, operating range 140 – 270V AC supply voltages. The luminaire driver shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN170C LED20S_Series/equivalent from approved make list</p>
5	2BHK	L5	<p>Bulkhead Light 10W-1000lm IP65</p>	<p>Supply of Endura Surface mounted LED Bulk head light made up of pressure Die Cast Housing, Wattage-10W,1000lm, ingress protection of IP65, CCT 4000K, CRI>80,SDCM<5 Life Span 50K hours @L70, THD<10%, PF>0.85. The luminaire shall be designed for operations under diverse environment from -10 deg C to 45 deg C, Input Voltage Range 140-270V, surge protection 2.5KV, high transmission PC diffuser. Dimensions: 180mm X 98mm X 79mm. The fixture should be BIS certified. Manufacturer</p>

				shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted. Similar to above specs in Signify (Philips)/ WT202W LED10S_Series/equivalent from approved make list
6	2BHK	L6	Emergency light with Battery BackUp	Supply of twin head 15W Emergency light fixture fixture with Bateery Backup following the Norms and Guidelines.

LIGHTING SCHEDULE (3BHK-IIT GUWAHATI)				
S. No.	Areas	Light Legend as per Drawing	Fixture Type	Fixture Description
1	3BHK	L1	Surface Mounted Downlight	<p>Supply of LED Surface mounted Downlighter having dia of 153mm(± 3mm) & height of 60mm(± 3mm) delivering minimum system lumen output of 1500 lumens and system wattage of 13.5W & with a minimum system efficacy of 110 lm/W. The luminaire should have a color temperature of 6500°K/4000K, CRI≥80 and SDCM≤5. The driver shall have THD≤10% (@full Load) and PF ≥ 0.95 (@full load). The luminaire housing should made of pressure die-cast aluminum. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, The fixture should comply with the parameters as per IS10322. The luminaire shall have impact resistance of IK02 & ingress protection of IP20. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accredited lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire. Similar to above specs in Signify (Philips) Model No SM296C LED15S_Series/equivalent from approved make list</p>

2	3BHK	L2	Wall Bracket Light+E-27 Holder type LED bulb	Supply of Single head Wall Bracket light, Made up of Stainless steel base and Opal White painted Glass cover with E-27 Lamp base to fix E-27 Holder type bulb having wattage upto 20W, Similar to above specs in Signify (Philips) HDL Model No.58185+Philips E-27 18W holderLED bulb/equivalent from approved make list
3	3BHK	L3	2FT,LED Batten Light 11W- 1200lm,IP20	Supply of LED Batten light of 2ft length with a system wattage of 10-11W with a nominal system lumen output of 1100-1200 lumens and a minimum system efficacy of 110lm/W. CCT shall be 4000K and CRI ≥ 80. Housing shall be extruded aluminium with powder coating & with IP20 protection. The luminaire shall meet IP20 rating with THD≤20% and PF ≥ 0.90.The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accredited lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN021 LED12S_Series/equivalent from approved make list
4	3BHK	L4	4FT,LED Batten Light 18W- 2000lm,IP20	Supply of LED Batten in 18W, 2000 lm, 4ft Extruded aluminum housing fitted with engg. Plastic end plates. Easy fit profiles acrylic diffuser provides smooth light distribution. LED populated on PCB comprising of cool White LEDs connected in series parallel. CCT-6500K, THD<10%, driver efficacy>85%, surge protection 3KV, CRI>80, SDCM<5, power factor>0.95, efficacy 110lm/w. Driver: constant current output driver, operating range 140 – 270V AC supply voltages. The luminaire driver shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab

				to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN170C LED20S_Series/equivalent from approved make list
5	3BHK	L5	Bulkhead Light 10W-1000lm IP65	Supply of Endura Surface mounted LED Bulk head light made up of pressure Die Cast Housing, Wattage-10W,1000lm, ingress protection of IP65, CCT 4000K, CRI>80,SDCM<5 Life Span 50K hours @L70, THD<10%, PF>0.85. The luminaire shall be designed for operations under diverse environment from -10 deg C to 45 deg C, Input Voltage Range 140-270V, surge protection 2.5KV, high transmission PC diffuser. Dimensions: 180mm X 98mm X 79mm. The fixture should be BIS certified. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted.Similar to above specs in Signify (Philips)/ WT202W LED10S_Series/equivalent from approved make list
6	3BHK	L6	Emergency light with Battery BackUp	Supply of twin head 15W Emegency light fixture fixture with Bateery Backup following the Norms and Guidelines.

LIGHTING SCHEDULE (Service Block-IIT GUWAHATI)				
S. No.	Areas	Light Legend as per Drawing	Fixture Type	Fixture Description
1	Service Block	L1	Surface Mounted Downlight	<p>Supply of LED Surface mounted Downlighter having dia of 153mm(± 3mm) & height of 60mm(± 3mm) delivering minimum system lumen output of 1500 lumens and system wattage of 13.5W & with a minimum system efficacy of 110 lm/W. The luminaire should have a color temperature of 6500°K/4000K, CRI≥80 and SDCM≤5. The driver shall have THD≤10% (@full Load) and PF ≥ 0.95 (@full load). The luminaire housing should made of pressure die-cast aluminum. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, The fixture should comply with the parameters as per IS10322. The luminaire shall have impact resistance of IK02 & ingress protection of IP20. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire. Similar to above specs in Signify (Philips) Model No SM296C LED15S_Series/equivalent from approved make list</p>

<p>2</p>	<p>Service Block</p>	<p>L2</p>	<p>4FT,LED Batten Light 18W-2000lm,IP20</p>	<p>Supply of LED Batten in 18W, 2000 lm, 4ft Extruded aluminum housing fitted with engg. Plastic end plates. Easy fit profiles acrylic diffuser provides smooth light distribution. LED populated on PCB comprising of cool White LEDs connected in series parallel. CCT-6500K, THD<10%, driver efficacy>85%, surge protection 3KV, CRI>80, SDCM<5, power factor>0.95, efficacy 110lm/w. Driver: constant current output driver, operating range 140 – 270V AC supply voltages. The luminaire driver shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN170C LED20S_Series/equivalent from approved make list</p>
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LIGHTING SCHEDULE (Gate House-IIT GUWAHATI)				
S. No.	Areas	Light Legend as per Drawing	Fixture Type	Fixture Description
1	Gate House	L1	Surface Mounted Downlight	<p>Supply of LED Surface mounted Downlighter having dia of 153mm(± 3mm) & height of 60mm(± 3mm) delivering minimum system lumen output of 1500 lumens and system wattage of 13.5W & with a minimum system efficacy of 110 lm/W. The luminaire should have a color temperature of 6500°K/4000K, CRI≥80 and SDCM≤5. The driver shall have THD≤10% (@full Load) and PF ≥ 0.95 (@full load). The luminaire housing should made of pressure die-cast aluminum. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, The fixture should comply with the parameters as per IS10322. The luminaire shall have impact resistance of IK02 & ingress protection of IP20. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire. Similar to above specs in Signify (Philips) Model No SM296C LED15S_Series/equivalent from approved make list</p>

2	Gate House	L2	2FT,LED Batten Light 11W-1200lm,IP20	Supply of LED Batten light of 2ft length with a system wattage of 10-11W with a nominal system lumen output of 1100-1200 lumens and a minimum system efficacy of 110lm/W. CCT shall be 4000K and CRI ≥ 80. Housing shall be extruded aluminium with powder coating & with IP20 protection. The luminaire shall meet IP20 rating with THD≤20% and PF ≥ 0.90.The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accrediate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) BN021 LED12S_Series/equivalent from approved make list
3	Gate House	L3	Canopy Light	Supply of High Pressure Die Cast Aluminium (LM6) Alloy hosing SMD LED Recessed Highbay Luminaire of 70watt 9000 system lumen, product with Compnay LOGO Engraved.system wattage Max 70watt narrow beam optics with 60 degree Rotational symmetry beam (for high ceiling heights),PC material Penuts Lenses for effective light distribution, .Corelated Color Temp 5700k,CRI>70,Maintenance of lumen L70 (Hrs) 50K@L70,Ambient temperature (Ta) 45Degree, Operating Temperature range up to 50degree, optics widebeam optics,optical cover glass.Aluminium PDC Housing. Protection of Fixture:- IP65,IK08,Class I,Line Frequency 50/60 HZ,power factor >0.95,Thd<=10% , Driver Efficiency >90%,Surge protection 4KV,Votage

				<p>range 140-270V AC, Lumen standard /Test certificate as per IEC 60598 and IS10322.The fixture should comply with the parameters as per IS10322. The LED driver should comply to IEC61000-3-2 ed.3.2, 2009 for Harmonics, IEC61347 -2 -13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, IEC62384 ed.1.1, 2011 for performance and IEC61547 ed.2.0, 2009, CISPR-15 for EMI.Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Fixture and driver have to be BIS certified as per the govt rule. Signify (Philips) Model No.BY286V_Series/equivalent from approved make list</p>
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LIGHTING SCHEDULE (Landscape-IIT GUWAHATI)				
S. No.	Areas	Light Legend as per Drawing	Fixture Type	Description
1	Landscape	L1	Post top	<p>Supply Installation, testing & commissioning of circular LED post having housing made of pressure die-cast aluminium (including top canopy & pole mounting piece) with integrated optics & having Polyester powder coating in addition to a specific weathering resistance treatment. The dia of the post top shall be minimum 450mm & height of minimum 200mm (including the pole mounting piece). The colour shall be RAL 7011 textured. The post top shall have Non-yellowing transparent and textured polycarbonate diffuser, 1.5mm thick. It should have concentric circular radial pattern for reduced glare & even light distribution. The luminaire must have round symmetrical optics/distribution. The luminaire shall be IP66 rated (without any glue) & shall have IK10 rating. The post-top shall have simplified extraordinary maintenance by an easy-to-remove driver compartment from top using allen key. The luminaire shall use high performance LEDs having CCT of 5700°K, CRI ≥ 70 & SDCM ≤ 5. The luminaire shall deliver initial system lumen output of minimum 50000lumens@46w& must have system luminous efficacy ≥110lm/w. The luminaire shall have Class-I electrical insulation & Serviceability of Class-B. The luminaire shall use BIS registered electronic driver having voltage range of 122V-277V with in-built surge protection of 4KV, THD≤10%. The driver shall have high cut-off (>325V±15V) & auto restart. The luminaire shall have in-built additional SPD of 10KV. The pole mounting piece shall be suitable for mounting on pole dia of 60mm. The luminaire shall have nominal weight of 4KG. The luminaire shall be BIS registered. The luminaire driver & SPD shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The the successful bidder must submit the NABL accreditation</p>

				<p>certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accredited lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) Model No.BGP300 LED50_Series/equivalent from approved make list</p>
2	Landscape	L2	Bollard	<p>Supply of Architectural bollard LED 3000K 230-240Vac 50-60Hz CRI > 80 Input power: 10W (±10%) Height 750mm, Electronic driver ON/OFF CE and RoHS compliance TYPE: Bollard, IP rating IP65, impact resistance IK07. MATERIAL CHARACTERISTICS : aluminium bottom pipe with polycarbonate diffuser and. Luminaire contains built in LED modules. Operating ambient temperature range is from 0 to +40°C. Lumen output 800 lm (±10%), Housing Color Dark grey RAL 7043. CCE, CE and RoHS compliance. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted. Similar to above specs in Signify (Philips) Model No.BGP151 LED150_Series/equivalent from approved make list</p>
3	Landscape	L3	Step light	<p>Supply, Installation, Testing and Commissioning of integral driver LED Steplight with a system lumen output of 40 lumens and a minimum system efficacy of 10 lm/W. The luminaire shall have a rated system lifetime of 25,000 burning hours at L70. The luminaire should have a color temperature warm white and CRI > 75. The luminaire shall meet IP67 rating with THD < 20% and PF > 0.9. The luminaire shall have polycarbonate diffuser. The total power consumption should not exceed 4W (including driver). Similar to above specs in Signify (Philips) Model No.BWG150 LED50_Series/equivalent from approved make list</p>

4	Landscape	L4	Wall Washer	Supply of Up-Down Wall Washer 10W-950lm,made up of Aluminium Die-casted housing, Integrated LED Similar to above specs in Signify (Philips) HDL Model No-582061/equivalent from approved make list
5	Road lighting	L5	Street light	Supply, Installation, testing & commissioning of high-quality group control enabled integrated LED Street Light with a minimum system lumen of 8400 lm and system wattage not exceeding 60W with a nominal system efficacy of 140 lumen/watt. The LED used shall have CCT of 5700K, SDCM \leq 5 and CRI \geq 70. The housing should be made of LM6/ADC12 Alloy, non-corrosive Single Piece pressure die-cast aluminum, to withstand extreme environments. The spigot shall be part of "Single Piece Pressure Die-cast housing" & shall not be bolted to the luminaire housing to ensure robust design. The name of the brand should be embossed/engraved & should not be mentioned using sticker/screen printing. It should have corrosion resistant powder coating to pass NSS of 500 Hrs. The luminaire LED shall have declared Lifetime of 75K hours@L70. The product should be designed for continuous operation (10-12 Hrs. per day). The Ingress protection should be minimum IP66 & impact resistance shall be IK10. The minimum luminaire dimensions shall be L: 490mm, W: 125MM, H: 135MM & nominal weight shall be 1.5KG (\pm 5%). Control gear compartments shall be Top maintainable without accessing/opening the optical compartment. The Luminaire should have a minimum 20 KV/10KA SPD du2ly bolted in the Luminaire. The SPD should be able to sustain a minimum 15 hits of 10KA rating i.e. Total of 45 hits across all the three modes as per IEEE 62.41.2. The luminaire should be of Class B Serviceability. The LED used in the luminaire shall be SMD type only & shall be from either Lumileds, Osram, Nichia, Cree & APT Electronics make or equivalent from approved make list . The Driver should be asphalt potted & should be a BIS approved driver. The driver shall have operating voltage of 120V to 270V, PF \geq 0.95 @ full load, THD \leq 10% @ full load. The driver should be capable of withstand voltage stress

				<p>of 440V for 8 Hrs., should have an auto shutdown @ 325V(±15V) and have an auto recovery feature. The driver shall comply to IEC61547 & IEC 61000-3-2. The luminaire driver & it's SPD shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & it's driver both should be BIS registered. Successful bidder shall submit the following reports before supply of material for approvals: LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test report for luminaire as issued by NABL accredited lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Signify (Philips) Model No BRP501 LED084_Series/equivalent from approved make list</p>
6	Landscape	L6	Spike light	<p>Supply of Spike mounted fixture LED 3000K CRI > 80 Input power: 12W 625lm , inbuilt Electronic driver ON/OFF CE/CB, IP rating IP65, Mechanical resistance IK06. MATERIAL CHARACTERISTICS : Die - Cast aluminium housing with electrostatic powder coating & high quality temper glass with precise PMMA optics for light distribution . Ground mounting spike made of die cast aluminum. Electrostatic powder coated. This luminaire contains built-in LED modules. Operating ambient temperature range is from -40°C to +50°C. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Both the fixture and Driver should have separate BIS approval. Similar to above specs in Signify (Philips) Model No HDL 31386/equivalent from approved make list</p>

7	Landscape	L7	Postop Light	<p>Supply Installation, testing & commissioning of circular LED post having housing made of pressure die-cast aluminium (including top canopy & pole mounting piece) with integrated optics & having Polyester powder coating in addition to a specific weathering resistance treatment. The dia of the post top shall be minimum 598mm & height of minimum 265mm (including the pole mounting piece). The colour shall be RAL 7011 textured. The post top shall have Non-yellowing transparent and textured polycarbonate diffuser, 1.5mm thick. It should have concentric circular radial pattern for reduced glare & even light distribution. The luminaire must have round symmetrical optics/distribution. The luminaire shall be IP65 rated (without any glue) & shall have IK07 rating. The post-top shall have simplified extraordinary maintenance by an easy-to-remove driver compartment from top using allen key. The luminaire shall use high performance LEDs having CCT of 5700°K, CRI ≥ 70 & SDCM ≤ 5. The luminaire shall deliver initial system lumen output of minimum 2500lumens@29w & must have system luminous efficacy ≥ 110lm/w. The luminaire shall have Class-I electrical insulation & Serviceability of Class-B. The luminaire shall use BIS registered electronic driver having voltage range of 122V-277V with in-built surge protection of 4KV, THD ≤ 10%. The driver shall have high cut-off (>325V ± 15V) & auto restart. The luminaire shall have in-built additional SPD of 10KV. The pole mounting piece shall be suitable for mounting on pole dia of 60mm.. The luminaire shall be BIS registered. The luminaire driver & SPD shall be of the same make/manufacturer as that of LED luminaires. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322. The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with Technical bid. The LED Luminaire & its driver both should be BIS registered. Successful bidder shall submit</p>
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				the following reports before supply of material for approvals LM79 issued by NABL accredited lab, LM80 issued by LED manufacturer, Type Test Certificate for luminaire as issued by NABL accreditate lab, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire & Driver. Similar to above specs in Signify (Philips) Model No.BGP161 LED25_Series/equivalent from approved make list
8				Supply of 6M Galvanized Octagonal Pole Suitable for Mounting of Street Light Philips Model No.BRP501 or equivalent from approved make list
9				Supply of 4M Round Cross Section Pole Suitable for Mounting of Pole light Philips Model No.BGP300 or equivalent from approved make list

LIGHTING SCHEDULE (Façade Lighting-IIT GUWAHATI)

S. No.	Areas	Light Legend as per Drawing	Fixture Type	Description
1	Front Façade	L1	Flood Light Monocolor 80W-6000lm	Supply of Circular shape architectural 3000K/4000K LED flood light with integral driver & housing made of Die-cast aluminium alloy - ADC12. The luminaire shall be no bigger than Ø 285 x 225 (±10%) with bracket. The luminaire shall have electrostatically applied polyester powder coating finish. The luminaire bracket shall be made of cold-rolled steel & shall be so designed that the luminaire can be tilted to ±90°. The bracket shall have locking mechanism to fix & secure the desired tilt angle. The luminaire shall have silicon gasket between optical cover & LED chamber to ensure proper IP66 protection. The luminaire must have a breather gland. The nominal weight of the luminaire shall be 8 KG (±10%). The luminaire shall be equipped with high-power Cree, osram, lumiled or equivalent from approved make list . The fixture shall have 3.5° beam angle & the lens shall be made of anti-aging & anti UV-PMMA material. The optical cover shall be made

				<p>of IK06 rated clear tempered glass. The LEDs shall have minimum CRI ≥ 80 for white light & shall have SDCM ≤ 4. The fixture shall come with power & DMX cable of minimum 100mm length. The fixtures shall be installed with have IP67 connectors. The luminaire shall have system wattage not exceeding 80W and system lumen output of not less than 6000 lumens ($\pm 10\%$). Fixture shall operating temperature range of 40°C to 50°C. The fixture shall have an integral driver with input voltage for 220-240 VAC, 50/60Hz. The luminaire shall have declared life of 50,000 burning hours at L70 @ 35deg. The luminaire shall have class I insulation. The luminaire shall automatically addressable using hand-held addressing device. The luminaire shall give feedback on luminaire address & status (ON & Off). The successful bidder shall submit the following certifications/reports for approval before supply of materials: product data sheets, LM79 report from NABL accredited lab, illuminance diagram, polar curve & LM80 report issued by LED manufacturer & RoHS Compliance along with CE certificate. The bidder shall upload the luminaire BIS certificate along with technical bid. The luminaire shall be supplied with necessary connectors for connecting lead/jump cables. Similar to above specs in Signify (Philips) Model No-BVP373 M 30LED_Series/equivalent from approved make list</p>
2	Façade Crown	L2	IP68 Outdoor Strip Light	<p>Supply of LED Strip light suitable for Outdoor A 3000k with Wattage of 8.2W/Mtr and lumen ou operating temperature range of -40°C to 50°C accredited lab, illuminance diagram, polar curve part sourced Driver and Aluminium Pr BGC301_Series/equivalent from approved</p>
3	Façade	L3	Linear grazer-100W-7345lm	<p>Supply of 1000mm long rigid architectural 3000K LED Linear light with integral driver & housing made of Extruded aluminium alloy 6063 grade & die-cast aluminium end caps. The luminaire shall have electrostatically applied polyester powder coating finish. The luminaire width shall be</p>

				<p>1000mm length, 158mm width & 88mm of height with brackets. The luminaire's integrated brackets shall be made of extruded aluminium & the same shall be so designed that the luminaire can tilt $\pm 58^\circ$. The luminaire shall have silicon glue between optical cover & LED chamber to ensure proper IP66 protection. The luminaire shall be equipped with high-power Cree, osram, lumiled or equivalent from approved make list. The fixture shall have $7.5^\circ \times 7.5^\circ$ beam angle & the lens shall be made of anti-aging & anti UV-PMMA material. The optical cover shall be made of IK06 rated clear tempered glass. The LEDs shall have minimum CRI ≥ 80 & shall have SDCM ≤ 4. The fixture shall come with power & DMX cable of minimum 100mm length. The fixtures shall be installed with have IP67 connectors. The luminaire shall have system wattage not exceeding 100W and system lumen output of not less than 7345lumens($\pm 10\%$). Fixture shall operating temperature range of -40°C to 50°C. The fixture shall have an integral driver with input voltage for 220-240 VAC, 50/60Hz. The luminaire shall have declared life of 50,000 burning hours at L70 @ 35deg. The luminaire shall have class I insulation. The luminiare Shall have integrated driver. The luminaire shall be compatible with DMX512 controller. The luminaire shall automatically addressable using hand-held addressing device. The successful bidder shall submit the following certifications/reports for approval before supply of materials: product data sheets, LM79 report from NABL accredited lab, illuminance diagram, polar curve & LM80 report issued by LED manufacturer & RoHS Compliance along with CE certificate. The luminaire shall be supplied with necessary connectors for connecting lead/jump cables & necessary endplates/covers. Similar to above specs in Signify (Philips) Model No. BCP38S M_Series/equivalent</p>
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<p>4</p>	<p>Façade</p>	<p>L4</p>	<p>Linear grazer-36W-2300lm</p>	<p>Supply of 1000mm long rigid architectural 3000K LED Linear light with integral driver & housing made of Extruded aluminium alloy 6063 grade & die-cast aluminium end caps. The luminaire shall have electrostatically applied polyester powder coating finish. The luminaire width shall be 1000mm length, 38mm width & 47mm of height with brackets. The luminaire's integrated brackets shall be made of extruded aluminium & the same shall be so designed that the luminaire can tilt $\pm 95^\circ$ The luminaire shall have silicon glue between optical cover & LED chamber to ensure proper IP66 protection. The luminaire shall be equipped with high-power Cree, osram, lumiled or equivalent from approved make list . The fixture shall have 17°X17° beam angle & the lens shall be made of anti-aging & anti UV-PMMA material. The optical cover shall be made of IK06 rated clear tempered glass. The LEDs shall have minimum CRI ≥ 80 & shall have SDCM ≤ 4. The fixture shall come with power & DMX cable of minimum 100mm length. The fixtures shall be installed with have IP67 connectors. The luminaire shall have system wattage not exceeding 36W and system lumen output of not less than 2300lumens($\pm 10\%$). Fixture shall operating temperature range of -40°C to 50°C. The fixture shall have an integral driver with input voltage for 220-240 VAC, 50/60Hz. The luminaire shall have declared life of 50,000 burning hours at L70 @ 35deg. The luminaire shall have class I insulation. .The luminaire shall be compatible with DMX512 controller. The luminaire shall automatically addressable using hand-held addressing device.The successful bidder shall submit the following certifications/reports for approval before supply of materials: product data sheets, LM79 report from NABL accredited lab, illuminance diagram, polar curve & LM80 report issued by LED manufacturer & RoHS Compliance along with CE certificate. The bidder shall upload the luminaire BIS certificate along with technical bid.The Luminaire, Controller & Accessories should be of same make. The</p>
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				luminaire shall be supplied with necessary connectors for connecting lead/jump cables & necessary endplates/covers. Similar to above specs in Signify (Philips) Model No BCP382 36LED_Series/equivalent from approved make list
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Note: Light fittings to be specified as per the catalogue no. reference of 1 company. The contractor can use equivalent from approved make list fitting from the approved brands listed in the approved makes subject to approval of EIC.

1. Minimum size of copper conductor for power wiring shall be 4 Sq mm for normal 16Amp sockets. For industrial sockets & sockets higher than 16Amp, 6/10 sq.mm. wire shall be used as per direction of the EIC. Fan points wiring shall be 1.5 sq mm.
2. UPS, Light & Power DBs shall be separate. The size of DBs at one location shall be same irrespective of number of circuits connected from the DBs.
3. The wiring and conduit route plan/drawings shall be submitted by the contractor and shall be got approved from the Engineer-in-charge.
4. To facilitate drawing of wires, 18 SWG GI fish wire shall be provided in recessed conduit. Conduits laid for other services, like fire alarm, Evacuation system etc., where wiring is not done along IEI works, fish wire shall be invariably drawn.
5. The connection between incoming switch/ isolator and bus bar shall be made with suitable size of thimble and cable.
6. Power supply to DBs located in lift machine room at suitable location as approved by Engineer-in-charge shall be done using suitable XLPE insulated armored cable. Supply of cable shall be in the scope of work.
7. Size of distribution board shall be as per number of light/ power circuits. All distribution boards shall be double door type IP43 in 1.6mm thickness, PAN assembly. RCBO of suitable rating shall be provided as main incomer in all DBs as per IEC 61439-3.
8. In vertical DBs used for power distribution main incomer shall be MCCB of 35/36KA rating breaking capacity.
9. Inside the lift shaft there shall be arrangement of one light point at each floor level and one light point at overhead, one light point in lift pit. All light points shall be in group controlled and wired with 2.5 sq.mm FRLS copper conductor cable. 15 amp power plug and 5 amp power plug shall be provided at each floor. Wiring of these power plugs shall be done with 4 sq.mm FRLS copper wires. LED Bulk head fittings of suitable rating to provide minimum 100 lux shall be connected with each point of lift shaft.
10. The breaking capacity of MCCB for all types of panel boards except DBs shall be as per fault level of that location. The rated service breaking capacity should be equal to rated ultimate breaking capacities ($I_{cs}=I_{cu}=100%$). Where I_{cs} is service breaking capacity and I_{cu} is ultimate breaking capacity and they should be of approved make. MCCBs above 200A of 35 /36 KA breaking capacity rating shall be provided with microprocessor relay with suitable fault level with adjustable O/L, S/C, protection and upto 200A with Thermal Magnetic release of suitable fault level having both adjustable settings for O/L and S/C.
11. All types of panel shall be fabricated from approved firms and strictly as per CPWD specifications. The drawing of panel boards must be got approved from Engineer – in – charge before fabrication work. The panel board shall consist of MCCB as incomer and outgoing, aluminium bus bar, digital type ammeter, voltmeter OR multifunction meter, selector switches, LED type indication lamps etc. as per standard sound engineering practice.

12. Rising mains: Upward transmission of power inside the buildings (Hospital Building and R&D block) shall be done with the sandwich compact type rising mains with busbar i/c all accessories i.e. adapter box, cable end box, tap-off box with MCCB. Rising mains shall be provided separately for **Light & Power, UPS & AHU's** shall be as per GFC drawings. Rating of rising mains shall be decided as per maximum load of the building and future expansion and as approved by Engineer – in –Charge. Rising mains shall be conforming to IEC 61439 as amendment up to date. The rising main shall be as per ECBC 2017.
13. After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2023 & Indian Electricity Rules 1956, shall be recorded and submitted to the department.
14. Lightning arresters shall be provided for building as per IS; 2309-1989 as amended up to date and CPWD specifications for internal work – 2023 shall also be provided.
15. RCBO of required ma (As per norms) sensitivity of suitable rating, selective short circuit of 10ka with distinctive fault indication of Earth, Short Circuit, overload shall be provided as Incomer of each Distribution board.
16. For accommodating various size of cables incoming to the building, Medium class G.I. pipe of suitable size shall be provided.
17. Earthing: Earthing system comprising of earth electrode, earth conductor, earth bus, protective conductor etc. for building shall be as per provision laid down in CPWD specifications part – I, 2023. Earthing system should be in such a way to maintain earth resistance as specified in CPWD specifications. Earth resistance shall be checked/ tested in harsh climatic conditions.
- 18. All External lighting shall be as per GFC drawings & lighting schedule.**
19. The light luminaries/electrical light fixtures provided under the contract shall be guaranteed for a period of 5 years from the date of completion/ handing over whichever is later. In this regard contractor shall furnish an undertaking and bond for Guarantee/Warranty of 5 years.

3. SUB-STATION WORK

GENERAL

SCOPE OF WORK:

The specifications given below pertain to the entire electrical sub-station installation work to be carried as per Latest CPWD Specification/NBC-2016/relevant IS Codes/State by Laws etc.

Sub-station equipment are proposed to be located in the isolated building. The electrical sub-station consists of:

- HT Panel Room
- Transformer rooms
- LT Panel room
- DG sets

As per APDCL electric supply shall be available on 33kV for meeting electrical load requirements of AAHII. Electrical load will be fed from 2 Nos. 33 KV Independent Feeder provided by APDCL. The Power supply through underground HT Cable and shall be terminated to the 33 KV Substation.

4. HT PANEL TECHNICAL SPECIFICATIONS FOR SUB STATION WORKS

GENERAL SCOPE OF WORK:

The specifications given below pertain to the entire electrical sub-station installation work to be carried out in the Sub-Station.

H.T. Vacuum Circuit Breaker Switchboard (manufactured in OEM factory only)

This specification covers the technical requirements of three phase, 33 kV, front operated VCB switchboard.

Applicable Codes and Standards:

The manufacturing and performance of equipment shall be as per current statutory regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

Unless otherwise stated, the H.T. (33 kV) Vacuum Circuit Breaker switchboard shall conform to IS: 13118 (1991), IEC 62271- 100-200 and Indian Electricity Rules and Regulations amended up to date.

CONSTRUCTIONAL FEATURES:

GENERAL

The panel board shall be compact integrated indoor, metal clad, floor mounted, free standing, Roll on Floor Circuit breaker, sheet steel enclosed as per specifications. The panel board shall have compartmentalized design having separate compartment for Breaker, Busbar, Cable & CT, Instrument & relay and the panel to be internal arc type tested for 25kA AFLR for 1 second for cable, busbar and breaker chamber. Self-threading screws shall not be used in the construction of switchboard. The panel board shall be of totally enclosed design, dust tight and vermin proof and extensible type. The degree of Protection shall be IP4X as per IEC-60529. The equipment when assembled shall form a neat and compact unit and shall be complete with all supporting frame work, mounting channels, foundation bolts etc. and shall be designed so as to ensure complete inter-changeability of components from one panel to another.

Also the panel board shall be:

Provided with a metal steel frame made of structural steel channel section properly drilled for mounting the switch gear along with necessary mounting hardware (hardware shall be zinc plated and passivated);

Provided with gaskets all-round the perimeter of removable covers and doors

Provided with busbar of adequate rating.

Provided with Base Channel of ISMC-75

Provided with Four Lifting Lugs for each shipping section.

For Each Panel Bay Earthing Truck for each for Cable and Busbar Earthing shall be provided.

SHEET METAL WORKS

The panel board shall be made from CRCA sheet Steel/ALUZINC shall be as per CPWD specification amended upto date or OEM manufacturing standard and braced as necessary to provide a rigid support for all components. All panels and covers shall be properly fitted.

INTERLOCKS

Following minimum Interlocks shall be provided

Breaker insertion / withdrawal is possible only when breaker is in "OFF" position.

Breaker closing is prevented in intermediate position between "Service" and "Isolation".

Door padlocking Facility.

BUSBARS

The busbar shall be made of Electrolytic Copper flats as per IS:1897. The busbar shall be insulated, covered and supported on rigid epoxy support insulators. The bus bar sizes shall be as per Current ratings.

The bus bar shall be provided with the minimum clearances in air as per applicable standards for a 33 kV, 3 phase system.

Bus bar shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.

Separate supports shall be provided for each phase of the bus bars. If a common support is provided for all three phases, anti tracking barriers shall be incorporated.

Bus bar joints shall be complete with high tensile steel bolts and Belleville washers and nuts. Bus bars shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.

VACUUM CIRCUIT BREAKER

The Vacuum circuit breaker shall be trolley mounted for vertical isolation and horizontal withdrawal. It shall have motor operated spring charged stored energy mechanism. It shall be possible to put the Vacuum Circuit Breaker in the "Plug-in" condition or withdrawn to the 'Test' position.

The circuit breaker shall be provided with the necessary auxiliary contacts for indication, control, and interlocking or other purposes. Excluding the contacts already used for the circuits, four spare sets of contacts with three 'NO' and three 'NC' shall be left free in each unit. The Vacuum Interrupter should have 100 nos. of full load short circuit operations.

The panel should be tested with power frequency withstand voltage of 70 kV rms & Impulse Withstand Voltage of 170 kVp.

CURRENT TRANSFORMERS/ POTENTIAL TRANSFORMERS

Current transformers shall be Silica filled epoxy resin insulated.
All current transformers shall be earthed through a separate earth link.

NUMERICAL TYPE RELAYS

The Numerical Relays in general shall comply with the following requirements:

The offered relays shall be completely numerical with Protection elements realized using software algorithm. Hardware based measurement shall not be acceptable.

All the Relays shall belong to a common platform and shall be of single make **with numerical relays in Flush Mounted or Drawout casing.**

The relay shall be provided with at least 16 nos. digital inputs and 8 nos. output contacts. The digital inputs and outputs shall be freely configurable.

It shall be possible to energize the relay from either AC or DC auxiliary supply. **Numerical Relay shall have in built breaker failure protection as local breaker backup. Built in Trip Circuit Supervision to ensure healthy trip circuit and built in fault locator feature to display the location of fault.**

The offered relay shall have a comprehensive local MMI for interface. It shall have the following minimum elements to enable viewing and setting the relay locally.

Keypad keys identified by pictograms for intuitive navigation

- Graphical 128x64 LCD screen to display any character or symbol, along with facility to display mimic/SLD.
- Excellent display quality under all lighting conditions
- Control buttons (0/1) to operate the circuit breaker and/or other controlled object
- 8 freely programmable LEDs to identify easily the message showed
- Labels are printed on a transparent film allowing customization of the relay

The relay shall have a front Ethernet communication port for connecting to a local PC/Laptop for setting and viewing the data from the relay.

It shall be possible to provide the relay with at least two standard communication protocols (viz, MODBUS TCP/IP & IEC-61850) in addition to any proprietary protocols. and shall have KEMA IEC61850 edition 2 certificates which are within 5 years from the date of issue of the certificate.

The relays shall have the following tools for fault diagnostics.

Fault record – The relay shall have the facility to store at least 5 last fault records with information on cause of trip, date, time, trip values of electrical parameters.

Event record – The relay shall have the facility to store at least 500 sequence of event records with 1ms resolution.

Disturbance records – The relay shall have capacity to store at least 5 disturbance record waveforms with at least 2s duration each.

The offered relays shall have a battery backed real time clock for providing accurate time reference.

The relay settings shall be provided with adequate password protection.

The relay shall have comprehensive self-diagnostic feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay. Any failure

detected shall be annunciated through an output watchdog contact. The fault diagnosis information shall be displayed on the LCD and also through the communication port.

The device shall have screw terminals for connection of wires for all CT/VT inputs, power supply, logic inputs and outputs. The device shall have 4 CT inputs and 4 VT inputs. The PCB cards of the device shall be conformal coated.

Arc Flash Protection (applicable to full switchgear):

The arc flash protection system shall be installed into switchgear for protection against the internal arc flash in the switchgear in order to improve personnel safety, and to minimize damage to the switchgears, thus improving the availability of the electricity service.

The arc flash protection system shall consist of Central Unit, Slave Units and arc flash sensors. Arc flash sensors shall be installed in the cable chamber, busbar chamber and breaker chamber. It shall have facility to extend the arc flash protection system by adding more slave units and sensors. The arc flash central unit shall be the brain the arc protection system operation and it shall continuously supervise all slave unit and sensors; and it shall issue a self-failure alarm in case there any component of the system is disconnected or failed. Dedicated arc communication bus to be offered between the central unit and slave unit, removing the indefinite network (GOOSE based) timing. Central unit shall have LCD screen and key pad on the front. It shall have facility to store fault records (i.e. current and activated sensors information) and event records.

The arc protection system shall have IEC61850 communication protocols with 2 no. RJ45 ports at the rear.

The protection principle shall be based on two simultaneous conditions: -

- a. Rise of light intensity detected by arc flash monitoring units and sensors
 - b. Detection of the overcurrent by the central or current sensing unit
- And after detection of arc fault, it should give zone wise tripping within 8 ms.

Minimum Relay functions shall be as per below description.:

Incomer:

- a. PLC/BMS Compatible Feeder Protection Relay 50/51(3 phase overcurrent), 50/51N (Earth overcurrent), 67P (3 phase directional overcurrent), 67N (Earth fault directional overcurrent), 51V (Voltage controlled overcurrent), 37 (3 phase undercurrent), 46 (Negative phase sequence overcurrent), 59N (Residual over voltage), 32 (Directional Power protection (Under/Over active/reactive power)), 81U/O (Under/over frequency), 49 (Thermal overload), 25 (Sync Check), 79 (Autoreclose), 50BF (Circuit breaker failure detection), Cold load pick up, Inrush blocking (VAMP257 or equivalent from approved make list .
- b. Master Trip Relay.
- c. Arcflash protection for cable busbar and breaker chamber.
- d. Thermal monitoring for Breaker terminals and busbar communicated to PLC.
- e. Communication with Dual Ethernet port over IEC61850 and LCD with Mimic and webserver.

Outgoing Feeder

- a. PLC/BMS Compatible Feeder Protection Relay 50/51(3 phase overcurrent), 50/51N (Earth overcurrent), 67P (3 phase directional overcurrent), 67N (Earth fault directional overcurrent), 51V (Voltage controlled overcurrent), 37 (3 phase undercurrent), 46 (Negative phase sequence overcurrent), 59N (Residual over voltage), 32 (Directional Power protection (Under/Over active/reactive power)), 81U/O (Under/over frequency), 49 (Thermal overload), 79 (Autoreclose), 50BF (Circuit breaker failure detection), Inrush blocking. (VAMP257 or equivalent from approved make list)
- b. Master Trip Relay
- c. Transformer Fault Alarm/Trip Aux. Relay along with window facia as per requirement. For Transformer Feeder only
- d. Arc-flash protection for cable busbar and breaker chamber.
- e. Communication with Dual Ethernet port over IEC61850 and LCD with Mimic and webserver.

5. OIL FILLED TYPE TRANSFORMERS (Level-2)

1.0 SCOPE :

This specification generally describes the power transformers and associated auxiliary equipment for use on the electrical power distribution system suitable for outdoor installation and covers the design, manufacture, testing at works, supply and delivery, Loading/ Un-Loading, site erection, testing and commissioning aspects of the same. The details are given in the data sheet.

2.0 STANDARDS :

- 2.1 The equipment and accessories covered by this specification shall be designed, manufactured and tested in compliance with the latest relevant standards published by the Indian Standards institution wherever available in order that specific aspects under Indian conditions are taken care of.
- 2.2 The equipment and accessories for which Indian Standards are not available shall be designed, manufactured and tested in accordance with the latest standards published by any other recognized national standards institution.
- 2.3 The equipment shall also conform to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified therein for installation and operation of electrical plants.
- 2.4 Generally the transformer shall conform to IS:2026, IS:10028 and unless otherwise stated. Following standards shall also be applicable.
 - i. IS 2026 Specification for Power Transformers.
 - ii. IS 1180-1 Outdoor type, Oil immersed, distribution Transformers upto and including 2500 KVA, 33KV.
 - iii. IS: 3639 Specification for Fittings and Accessories for Power Transformers
 - iv IS: 6600 Guide for loading of oil immersed transformers
 - v IS: 335 New insulating oils
 - vi IS: 1271 Thermal evaluation and classification of electrical insulation
 - vii IS: 2099 Bushings for alternating voltages above 1000 Volts
 - viii IS: 60529 Degrees of protection provided by enclosures for low voltage switchgear and control gear
 - ix IS: 2705 Current transformers
 - x ECBC-2017
 - xi CBIP Manual on Transformer – 2007
 - xii NEMA TR-1
 - xiii NEMA TP-1, TP-2, TP-3

3.0 GENERAL CONSTRUCTIONAL FEATURES:

- 3.1 All materials used shall be of best quality and of the class most suitable for working under the site conditions and shall withstand the variations of temperature and atmospheric conditions, overloads, over excitation, short circuits as per applicable standards, without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.
- 3.2 The risk of accidental short- circuit due to birds or vermin are obviated. All apparatus, including bushing insulators and fittings shall be so designed that water cannot collect at any point. Marshalling kiosks, boxes etc. shall be adequately ventilated to prevent condensation of moisture and so treated internally as to prevent growth of fungi on any coils, wires and insulating materials used.
- 3.3 The transformers shall operate with minimum noise and vibration. The cores, tank and other structural parts shall be properly constructed so that the mechanical vibrations are kept to the minimum, thus reducing the noise.
- 3.4 The transformer shall be such that changes in transformer connection can be made by a simple change of link connection inside the tank. The transformers shall be designed to

suppress harmonic voltages, specially the third and fifth, so as to eliminate distortion in wave form, and the possibility of circulating currents between the neutrals at different transformer stations.

- 3.5 All transformers shall be of the latest design, oil filled as called for in the main specification. Transformers shall be suitable for outdoor installation. The type of cooling and the corresponding ratings for each transformer shall be as indicated in the main specification.
- 3.6 The magnetic circuit of each transformer shall be so designed as to minimize eddy-current and hysteresis losses in the core.
- 3.7 All electrical connections and contacts shall be of ample section for carrying the rated current without excessive heating.
- 3.8 All mechanisms shall be of stainless steel, brass, gunmetal, or other suitable material to prevent sticking due to rust or corrosion. Transformer shall be painted in RAL 7032.
- 3.9 Energy efficiency of transformers shall be Level-2 as per IS 1180.
- 3.10 Tank:
- i) The transformer tank shall be made of steel plate, shaped in such a way that minimum welding is required. The tank shall be electrically welded and all welding stresses shall be properly relieved. Tank walls shall be reinforced by adequate stiffeners to ensure mechanical rigidity permitting hoisting of complete transformers filled with oil and also to damp transformer-noise. The tank shall be sufficiently strong to withstand shocks likely to be encountered during transport of the transformer without any deformation or weakening of joints. The joints shall be oil-tight. Guides shall be welded on the inner side of the tank to facilitate tanking and unloading of the transformer core and coil assembly.
 - ii) Tank cover shall be bolted on to the flanged rim of the tank with a suitable weather-proof, hot-oil-resistant gasket in between for oil-tightness. The bolted tank cover shall be so arranged that it can be removed and the core inspected without removal of the radiators. All requisite access and inspection holes shall be provided with bolted oil-tight, gasket-seated cover-plates. Bushing-turrets, covers of access holes, covers of pockets to prevent leakage of water into the tank shall be provided.
 - iii) The exterior of tank and other steel surface exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather resistant nature preferably of distinct colour from the prime and finish coats. The final coat shall be of a glossy, oil and weather resisting non-fading paint of specified shade. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant and oil insoluble paint.
 - iv) Steel bolts and nuts exposed to atmosphere shall be galvanized however, surfaces of the transformer or other parts of the transformer or auxiliary equipment which are in contact with oil shall not be galvanized.
 - v) The transformer tank, auxiliary equipment and fittings shall be provided with necessary devices for lifting and haulage facilities. The tank shall be mounted on a substantial under-carriage.
 - vi) Unless otherwise stated the tank together with radiators, conservator, bushings and other fittings shall be designed to withstand without permanent distortion the following conditions.
 - a) Full vacuum of 760mm of Hg for filling oil by vacuum.
 - b) Internal gas pressure of 0.35 Kg/Sq.cm. with oil at operating level.Valves shall not leak nor any welded joints sweat under above conditions.
 - vii) Adequate space shall be provided at the bottom of the tank for collection of sediments.
- 3.10 Core:

- i) The magnetic circuit shall be built of "High Grade" cold rolled grain oriented low loss steel stampings having high permeability and conforming to adopted standards. Stampings shall be insulated from each other with material having high interlamination insulation resistance and rust inhibiting property and also capable of withstanding pressure, mechanical vibration and action of heat and oil, thus reducing the possibility of sludge formation to a minimum.
- ii) The framework, clamping arrangement and general structure of the cores of each transformer shall be of robust construction and shall be capable of withstanding any shock to which they may be subjected during transport, installation and service. The assembled core shall be securely clamped, on the limbs and the yoke, to build up a rigid structure. The clamping pressure shall be uniform over the whole of the core and so adjusted as to minimize noise and vibration in the core when the transformer is in service. The framework and the core bolts shall be efficiently insulated from the core so as to reduce the circulating currents to a minimum.
- iii) The core clamping frame shall be provided with lifting eyes for the purpose of tanking and untanking the core with winding mounted thereon and shall have ample strength to take the full weight of the core and winding assembly.
- iv) An approved type of core grounding system shall be used; the grounding connections being located at the top of the core for easy access from the inspection hole.

3.11 Winding:

- i) The coils used for transformer winding shall be circular in shape, made of paper insulated, continuous and smooth, tinned or enameled electrolytic copper conductors of high conductivity.
- ii) The transformer winding shall be designed for basic impulse insulation level not lower than that specified in the main specification.
- iii) Liberal ducts shall be provided to prevent any hot spot temperature in the winding that may adversely affect the life of the transformer. Adequate supports, wedges and spacers of hard insulating material shall be so fitted that they will neither move nor permit relative movement of any part of winding during transit of normal service or under terminal short-circuit, nor damage the winding insulation in any way. All leads and connections shall be robust, adequately insulated, protected and clamped. The winding assembly shall be dried in vacuum with tested insulating oil of approved standard. The windings shall be subjected to a thorough shrinking and seasoning process so that no further shrinkage of windings occur during service at site. However adjustable devices shall be provided for taking up any possible shrinkage of coils in service. The assembly shall be held in position under adequate axial compression to withstand the axial thrust likely to occur under terminal short-circuit.
- iv) The end turns on the high voltage winding shall have reinforced insulation to take care of the voltage surges likely to occur during switching or any other abnormal system condition.
- v) The transformers shall be suitable for operation at full rated power on all tapplings without exceeding the specified temperature rise as indicated in the applicable standards.

3.12 Insulating Materials:

- i) The insulating oil shall conform to IS-335 and shall be suitable in all respects for operating the transformer at the rating and under conditions specified in the main equipment specification.
- ii) The transformers oil shall be of low viscosity and shall offer the minimum resistance and maximum convective assistance to the flow. The oil shall be thin enough to penetrate into narrow ducts and assist in the circulation through transformer winding to prevent local over- heating. It must have low pour point. The viscosity of oil shall be such that the flow is not significantly impeded.

- iii) Oil shall have excellent chemical stability such that degradation due to decomposition of high molecular weighed hydrocarbon molecules into lighter, more volatile fraction shall not occur at normal operating temperatures.
- iv) The oil shall have high electrical strength, good impulse strength and good are quenching properties. It shall be clear, bright but non-toxic. It shall be free from objectionable quantities of elemental and thermally unstable sulphur bearing compounds. If present, these compounds shall not cause corrosion of metals used in transformer. The oil shall have ability to resist transient voltage stresses caused by lightning strokes and high voltage switching surges.
- v) Sufficient oil shall be supplied for the first filling of transformer, the oil circulating equipment and the tank containing tap-changing mechanism and an extra 10% shall be supplied in non-returnable drums. The tender shall contain information about the grades of oil recommended by the transformer manufacturer for use in the transformer. Test certificates for the oil shall be furnished before despatch of transformer and acceptance by owner.
- vi) Class A insulating materials specified in IS:1271 shall be used. Paper insulation shall be new and free from punctures. Wood insulation, where used shall be well seasoned and treated.

3.13 Tappings :

Full power tappings shall be provided on HT side as specified for variations in L.V. supply.

i) Tap Changer:

The tap-changer arrangement shall be provided on the H.T. side. The tap-changer shall be of an approved and tested design. The number of plus and minus taps shall be as specified in the data sheet. The change-over of taps shall be made simultaneously in all phases.

All switches and mechanism of the tap-changer shall be mounted in oil tanks or compartments, placed in an accessible position on the transformer tank. It shall not be possible for the oil from the chamber to mix with the oil in the main transformer. Suitable mechanism to lower the tank for inspection and maintenance of the tap-changer shall be provided.

ii) On-load Tap-changer (OLTC):

Where the main equipment data sheet/ Schedule of item calls for on load tap changer, it shall be of a design such that it may be easily adopted to operate by automatic control. The OLTC shall have arrangement for local and remote electric control and local hand operation as detailed below:

a) Manual Mechanical Control:

The cranking device for manual operation of OLTC shall be removable and suitable for operation at about 1200 mm above ground level. The mechanism shall be complete with the following:

- i) A mechanical tap position indicator. A counter device shall be fitted to indicate the number of operations completed by the equipment.
 - ii) Mechanical stops to prevent over cranking of the mechanism beyond extreme tap positions.

b) Electrical Control:

The electrical control shall have the following feature:

- i) It shall not be possible to energize the electric drive when the hand operating gear is in use.

- ii) It shall not be possible for local electric and remote electric control to be operated at the same time (i.e. a local and remote change over switch to be provided to cut off remote control during local electrical operation).
 - iii) Operation from the local or remote control switch shall cause one tap movement only, unless the control switch is returned to normal position between successive operations.
 - iv) On load tap changer equipment shall ensure that when a step movement has been commenced, it shall be completed independent of the operation of the control relays or switches. If a failure of the auxiliary power supply during a step movement or any other contingency would result in that movement not being completed, means shall be provided to safe guard the transformer and its auxiliary equipment against such condition.
- v) Limit switches shall be provided to prevent overrun of the on load tap changer mechanism & shall be directly connected into the circuit of the operating motor. A robust mechanical stop shall be provided to prevent over run of tap changer mechanism at the two extreme positions.

On load tap changer mechanism shall be protected against short circuit and overload by means of relays. The motor shall be enclosed in a ventilated weather proof housing. A tap-position indicator for on load tap changer to give indication of the tap positions shall be provided. The indicator shall show clearly the actual voltage ratio (in kilovolts) in use and shall show simultaneously the number representing this ratio. The number shall range from 1 upwards.

The lowest number shall be the tapping position corresponding to maximum number of high voltage winding turns i.e. plus percent position. The highest number shall represent the tapping position corresponding to the minimum number of high voltage winding turns i.e. minus percent position. Indicators for both local and remote control positions of on load tap changers shall be provided. Remote control indicator shall be mounted on separate control panel.

c) Remote Tap Changing Control Panel (RTCC Panel):

Remote control cubicle including all accessories required for remote operation of tap changer with following control items shall be supplied.

- i) Push Buttons for raise/lower operation of Tap changer.
 - ii) Tap position indicator (digital LED display type).
 - iii) Tap change in progress by means of indicating lamps.
 - iv) Local/ Remote switch position indication with lamps.
- v) An operation counter to register the accumulated number of tap changes preformed.

3.14 Cooling:

- i) Cooling shall be ONAN type.
- ii) The radiators shall be provided with butterfly type of shut off valves.
- iii) Cooling tubes/radiators shall permit every part of the cooling surface to be cleaned by hand.

3.15 Terminal Arrangement :

i) High Voltage Side (33KV) :

- a) Cable box shall be provided suitable for terminating 3no. 1C x 150 sq.mm and XLPE insulated armoured 33 KV cable as per schedule of Item. & SLDs. complete with disconnecting chamber, compression glands, tinned copper lugs, Armour earth clamp and body earth terminal.

ii) Low Voltage Side (433 V) :

- a) LT Termination box shall be suitable for terminating Outdoor Type, Sandwich, aluminium conductor Bus Duct of 4000A (after deration). Separate Adapter Box shall be provided for terminations as per site conditions.

iii) Bushing :

- a) Bushings shall confirm to IS: 2099 and other relevant standards.
- b) Bushings shall be supplied with terminal connector clamp suitable for connecting the bushing terminal to the owner's conductor.
- c) Creepage distance of bushing shall be (31mm/kv phase ground) adequately,

3.16 Marshalling Box :

- i) Whenever optional fittings, temperature indicators, with auxiliary contacts, Buchholtz Relay and Bushing CT's are specified then the bidder shall provide a marshalling box and marshall to it all the contact terminals of electrical devices mounted on the transformer. It shall be in the contractor's scope to provide:
- a) The interconnection cabling between the marshalling box and the accessory devices either by PVC insulated copper wire in G.I. conduits or PVC/ XLPE insulated copper conductor armoured cables.
- b) Necessary double compression type brass cable glands at the marshalling box for above cables.
- ii) The marshalling box shall be tank mounted, water/dust tight sheet steel (2mm thick) enclosed with hinged door having padlocking facility. All doors, covers and plates shall be fitted with neoprene gaskets. Top surface shall be sloped and bottom shall be atleast 600mm from floor and provided with gland plate and cable glands as required.
- iii) Terminals shall be clip-on type rated for 10A. All contacts for alarm/trip indication shall be potential free, wired up to the terminal block. Wiring shall be done with stranded copper conductor wires of sizes not less than 1.5 sq.mm for control and 2.5 sq.mm for CT circuits. C.T. terminals shall be provided with shorting facility.
- iv) The marshalling box shall be provided with illumination lamp and a 6 pin 5/15A socket outlet.

4.0 ELECTRICAL & PERFORMANCE REQUIREMENT:

- 4.1 Transformer shall operate without injurious heating at the rated KVA at any voltage within -15 % to + 5 % of the rated voltage of that particular tap.
- 4.2 Transformer shall be designed for 110% continuous over fluxing withstand capability.
- 4.3 The neutral terminals of the winding with star connection shall be designed for the highest over current that can flow through the winding.
- 4.4 Overloads shall be allowed with in the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tap-changers or other auxiliary equipment shall apply.
- 4.5 The Transformer shall be continuously rated for full load. The temperature rise shall not exceed 45 degree C by thermometer in oil or 40 degree centigrade by resistance over an ambient of 50 degree C as per IS 1180.

5.0 EARTHING:

5.1 Two separate earthing terminals to be provided at the bottom of the tank on opposite sides. The terminals shall be of clamp type suitable for connection to owners grounding strip (50x6mm).

5.2 Internal Earthing :

The frame work and clamping arrangements of core and oil shall be securely earthed inside the tank by adequately sized copper strip connections to the tank.

6.0 FITTINGS AND ACCESSORIES:

The transformer shall be provided with all standard fittings and accessories specified in the applicable standard for the size and type of transformer concerned. The accessories and fittings shall generally be as specified below:

6.1 Oil Conservator:

The transformer to be provided with an oil conservator with welded end plates. It is to be bolted to the cover and can be dismantled for purpose of transport. It shall be provided with plain oil level gauge with marking for minimum level and an oil filling hole with a cap which can be used for filling oil. For draining purpose a plug shall be provided. An equiliser pipe between the conservator and the main tank is to be provided, which projects inside conservator. Separate conservator shall be provided for OLTC chamber.

6.2 Magnetic Oil Gauge (MOG):

MOG with low level alarm contacts shall be provided.

6.3 Breather:

The transformer shall be provided with an indicating dehydrating silica-gel breather with glass window for inspection of sufficient capacity.

6.4 Explosion Vent:

An explosion vent with diaphragm shall be provided for relieving the pressure within the transformer.

6.5 Diagram and Rating Plate:

Diagram and rating plate of stainless steel shall be provided indicating the details of transformer, connecting diagram, vector group, tap changing diagram etc.

6.6 Earthing Terminals:

Two earth terminals of adequate mechanical and electrical capacity shall be provided. One separate earthing terminal shall also be provided on each separate radiator banks.

6.7 Buchholtz Relay:

Double float buchholtz relay where specified shall have two separate sets of contacts, one for alarm and other for circuit breaker trip. The relay shall have a test pet cock. A small window in the wall of the relay shall be provided to show the amount of the trapped gas, if any. The construction of the transformers shall be such that all rising gas will be readily reach the buchholtz relay. Gas sampling device (Cu tubing with pet cock at one end) at an accessible height (about 1200 mm from GL) and an air release cock for Buchholtz relay shall be provided.

6.8 Dial type Thermometer (OTI):

Dial type thermometer (150mm dia) with maximum set pointer at 75 degrees c and electrical contacts for electrical alarm/trip at high temperature with thermometer pocket shall be provided.

6.9 Winding Temperature Indicator (WTI):

Shall comprise of:

- a. Temperature sensing element

- b. Image coil
- c. Bushing or turret mounted CT.
- d. Local indicating instrument with electrically independent trip/alarm contact brought out to separate terminals.

6.10 Lifting Lugs:

The arrangement for lifting the active part out of the transformer tank along with cover by means of lifting lugs without disturbing the connections shall be provided.

6.11 Swivel Type Rollers:

The transformer to be provided with 4 Nos bidirectional rollers fitted on cross channels to facilitate the movement of transformer in both directions.

6.12 Air Release Plugs:

An air release plug shall be provided on the top of the tank cover/radiators to facilitate the release of the entrapped air and filling of oil.

6.13 Drain-cum-oil Filter Valves with Plug on Cover Plate:

The transformer shall be provided with a drain-cum-oil filter valve with flanges and blanking plate & locking arrangement of atleast 1 1/2"BSP size at the bottom of the tank.

6.14 Filter valve of 1 1/4" BSP at top with flanges and blanking plate.

6.15 Sample valve with plug (1/2").

6.16 Inspection cover.

6.17 Oil filling hole with cap.

6.18. On-load Tap Changing Switch :
On load tap changer with local & remote electric control, having a position indicating plate & locking device.

6.19 Jacking Pads

6.20 Skids

6.21 Neutral bushing terminals complete with connector for earth conductor.

6.22 Neutral C.T as per specifications given in the data sheet the terminals shall be brought up to the marshalling box.

7.0 DRAWINGS AND O&M MANUALS:

7.1 Two sets of Hard copies and one set of soft copy of manual of complete instructions for the installation, operation, maintenance and repairs circuit diagrams, foundation and trenching details shall be provided with the transformers. List of spare parts shall also be indicated.

7.2 Two copies of the drawings incorporating the following particulars shall be submitted with the offer for preliminary study.

a) GA drawing showing dimension, net weight and shipping weight, quantity of insulating oil etc.

b) Crane requirements for assembly and dismantling of the transformer.

c) Drawing indicating GA of cable box and its dimension for cable entry cut out requirements etc.

7.3 The drawings in (Two sets) to be furnished by the supplier for approval after acceptance of his order shall include the following.

- a) GA showing front and side elevations and plan of transformer and all accessories and external features, detailed dimensions, crane lift for untanking, oil quantity, H.T./L.T. clearances etc.
 - b) Drawings of MV Bus duct termination arrangement/MV Cable box & disconnecting chamber.
 - c) HV cable box arrangement & disconnecting chamber GA & details drawings.
 - d) Drawing of each type of bushing.
 - e) Name plate and terminal making and connection diagram.
 - f) Control wiring & schematic diagram showing polarity and vector group of windings, CTs and OTI, WTI, circuits, OLTC control, Alarm/trip circuits etc.
 - g) GA of RTCC
 - h) Assembly of OLTC gear mechanism & details of mechanism parts, limits, contours of wearing parts, timing gear adjustments etc.
- 7.4 Reproducible (soft) copy of the above drawings for records.

8.0 TESTING:

The transformer shall be subjected to all routine tests in accordance with IS: 2026 at the factory before dispatching the same and test certificates shall be furnished.

- a) Measurement of winding resistance.
 - b) Ratio polarity and phase relationships.
 - c) Impedance voltage.
 - d) Load losses
 - e) No-load losses and No load current
 - f) Insulation resistance (Before & after carrying out all tests)
 - g) Induced over voltage withstand test
 - h) Separate source voltage withstand test
 - i) Temperature rise test.
- Bidders may quote rate for the HV impulse test. Alternatively they may submit the test certificate for the test conducted on the similar transformer. Owner reserves the right to exercise the option of carrying out H.V impulse test.

9.0 TEST REPORTS :

Four copies of the test reports in bound volume shall be submitted for approval.

10.0 SPARES :

The bidder shall quote itemised prices for his recommended spares for the period of operation of transformer for 5 years.

11.0 TRANSFORMER DATA SHEET

S. No.		Rating
		2500 kVA
1.0		
1.1	Application	Distribution, Mixed lighting, power and Motor loads.
1.2	Number	3 Nos. (2W + 1S)
1.3	Installation	
2.0	RATINGS	
2.1	Rating KVA	2500
2.2	Number of phases & Frequency	3 PHASE, 50Hz
2.3	Type of cooling	ONAN
2.4	No Load Voltage	
	HV	33000 V
	LV	433 V
2.5	Vector Group	DYn11
2.6	Percentage Impedance	6.25%
2.7	Class of insulation	Class A
3.0	VOLTAGE	
3.1	Nominal System Voltage	
	HV	33000 V
	LV	433 V
3.2	Highest System Voltage	
	HV	36000 V
	LV	433 V
3.3	Winding	
	HV	Copper
	LV	Copper
4.0	Energy Efficiency Level	Level-2 as per IS 1180 amended up to date
4.0	TAP CHANGING GEAR	
4.1	TAPS ON LOAD/OFF LOAD	ON LOAD
4.2	Tapping on windings HV/LV	HV
4.3	Total tapping range	+ 5 % to -15 %
4.4	Steps	2.5% (as per IS-1180)
4.5	No. of steps	9
5.0	TEMPERATURE RISE	
5.1	Ref. Ambient °C	50 Degree
5.2	Oil by thermometer °C	40 Degree
5.3	Winding by Resistance °C	45 Degree
6.0	Insulation level (Impulse withstand)(kVpeak)	
6.1	Impulse (1.2x50 micro second wave):	170 KV peak
6.2	Power Frequency (Dry & Wet)	
a)	HV	70 KV rms
b)	LV	3 KV rms
7.0	NEUTRAL EARTHING	
7.1	SYSTEM NEUTRAL Effectively Earthed / Resonant Non effectively Earthed/ Isolated	Effectively Earthed
7.2	TRANSFORMER NEUTRAL	Effectively Earthed

S. No.		Rating
		2500 kVA
7.3	Neutral CT.	4000/1A, CL-PS
8.0	VACUUM WITHSTAND CAPABILITY	
	Main Tank with bushing, Radiator, fittings & accessories	Full Vacuum
9.0	ACCESSORIES	
9.1	Dial type thermometer with Alarm and trip contacts	Yes
9.2	Magnetic Oil gauge with Alarm contact	Yes
9.3	Buchholtz Relay (Double float)	Yes
9.4	Winding Temperature Indicator	Yes
9.5	Wheels Plain/ Flanged/ bidirectional/ unidirectional	Flanged, bi-directional
9.6	Explosion Vent diaphragm	Yes
9.7	Silicagel Breather	Yes
9.8	Valves	Drain valve, Filter valve, Sampling valve etc., complete set with blanking plate/plugs.
10.0	TERMINATION ARRANGEMENT	
10.1	H.V. SIDE (CABLE BOX) (33KV)	Cable box and disconnecting chamber suitable for 3Rx1Cx150 Sq.mm 33 KV XLPE Al. Conductor armoured cable.
10.2	L.V. SIDE (CABLE BOX) (433V)	Outdoor Type, Compact, aluminium conductor Bus Duct of 4000A.
11.0	Guaranteed Losses	
11.1	Losses at 50% Load	6343 W
11.2	Losses at 100% Load	18813 W

12.0 DATA TO BE FURNISHED BY BIDDER:

1.0 POWER TRANSFORMER:

- 1.1 Name of Manufacturer :
- 1.2 Standards followed in design manufacture and testing :
- 1.3 Continuous rating in KVA :
- 1.4 Transformer no-load voltage :
- 1.4.1 High voltage :
- 1.4.2 Low voltage :
- 1.5 Vector group reference :
- 1.6 Temperature rise over specified ambient temperature in degree C :
- 1.6.1 In oil by thermometer :
- 1.6.2 In winding by resistance :
- 1.6.3 Maximum hot spot temperature in degree C :
- 1.7 Terminal Arrangement.

- 1.7.1 H.V. Side :
- 1.7.2 L.V. Side :
- 1.8. One-minute dry power frequency test withstand voltage in KV :
- 1.8.1 High voltage :
- 1.8.2 Low voltage :
- 1.9 Impulse test withstand voltage with 1.2 x 50 microseconds wave in KV :
- 1.10 Type of tap changer :
- 1.10.1 No. of plus taps :
- 1.10.2 No. of minus taps :
- 1.11 Iron losses in KW at rated voltage and frequency :
- 1.12 Copper losses in KW at rated full load current and frequency at 75 degree C :
- 1.13 Reactance voltage with guaranteed tolerance in percent at rated full load current and frequency 75 deg C :
- 1.14 Impedance voltage with guaranteed tolerance In percent at rated full load current and frequency at 75 deg C :
- 1.15 Regulation in percent of no-load voltage at full load current at 75 degree C and with power factors of :
- 1.15.1 Unity :
- 1.15.2 0.8 lagging :
- 1.16 Efficiency in percent at 75 degree C and unity power factor for :
- 1.16.1 100 percent load :
- 1.16.2 75 percent load :
- 1.16.3 50 percent load :
- 1.17 No-load current in amperes at rated voltage and frequency :
- 1.18 Inrush magnetizing current in percent of normal full load current. :
- 1.19 Details of winding insulation :
- 1.19.1 Class of insulation materials :
- 1.19.2 Turns insulation high voltage in meg ohm :
- 1.19.3 Turns insulation low voltage in meg ohms :
- 1.19.4 Insulation core to low voltage in meg ohms :
- 1.19.5 Insulation high voltage to low voltage in meg ohms :
- 1.20 Details of 415 V neutral current transformer :
- 1.20.1 Name of manufacturer :

1.20.2	Current ratio	:
1.20.3	VA capacity	:
1.20.4	Accuracy & performance characteristics	:
1.21	Quantity in liters and grade of oil	:
1.22	Weights	:
1.22.1	Grade of Core and weight in kg	:
1.22.2	Grade of Copper and weight of winding	:
1.22.3	Tank and fittings in kg	:
1.22.4	Oil weight	:
1.22.5	Complete transformer filled with oil	:
1.23	Overall Dimensions	:
1.23.1	Length in mm	:
1.23.2	Breadth in mm	:
1.23.3	Height in mm	:
2.0	Tests:	:
2.1	List of tests proposed to be carried out at the factory	:
2.2	List of tests proposed to be carried out at the site before commissioning.	:

6. LT SWITCHBOARD (PANEL) AND SWITCHGEARS

General

This section covers the detailed requirements of medium voltage switchboard for 415 volts, 3 phase, 50 Hz, 4 wire system.

Standards and Codes

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract.

Low Voltage switchgear Assemblies IEC 61439-1/2, Low Voltage switchgear & control gear IEC 60 947.

Part I : General rules

Part II : Circuit Breakers

Part III : Switches, disconnectors, switch disconnectors and fuse combination units

Part IV : Contactors and Motor starters

Part V : Control circuit devices and switching elements Degree of Protection of Enclosures for low voltage switchgear. IEC 60529, Internal arc – IEC 61641

LT SWITCHBOARDS

General

Main LT Panels (All Substation) shall be Type-Tested & certified under IEC 61439-1 & 2. The switchboards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc. shall be identical in construction to the assembly which has undergone the type test certification. The drawings of the type-tested assemblies shall be made available for inspection.

Switchboards shall have a short circuit level withstand as per Schedule of items and drawings.

The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 43 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 43 is retained. Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.

The switchboard along with ACBs and connections should have been type tested design at CPRI/ ERDA /Independent international test house for short circuit, temperature rise, protective earth short circuit test and dielectric tests of the ratings required.

Main LT Panel, HVAC Panel & APFC Panel (TTA Type Panel) shall comply following:

TTA Panels certified under IEC 61439-1 & 2. "Low-Voltage Switchgear and Control gear Assemblies"

Internal arc as per IEC 61641 for 85Ka for 0.5 sec at system design fault level on HBB, VBB and cable chamber.

Certified as per Seismic Zone 5 of IEC 60068-3-3, IS 1893 & ICC ES AC-156 requires compliance against acceleration

Form 4B IP2 X (touch proof) protection even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet/Hylem sheets shall not be allowed.

All Other panels (Block Panel, AHU Panel, Ventilation Panel, UPS Panel, MDB floor panel, Lift Panel) shall comply following:

PTTA type, IEC 61439-1&2. "Low-Voltage Switchgear and Control gear Assemblies"

NOTE: Copies of the test certificates/reports shall be submitted along with the tender.

Switchboard Configuration

The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MCB's and other equipment as called for in the schedule of quantities.

The MCCBs shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.

The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

OEM & Partner's name should be mentioned on Top of each all columns of switchboard.

There should be total discrimination between upstream and downstream switchgear & protection on devices i.e. ACBs, MCCBs etc. up to the service breaking capacity level as per IS/IEC -60947-2 for better continuity of supply and fault localization.

Constructional Features

The Switchboards shall be metal clad totally enclosed; floor mounted free-standing type of modular extensible design suitable for indoor mounting.

Switchboards construction shall employ the principle of compartmentalized and segregation for each circuit.

Incomer and bus section panels or sections shall be separate and independent and shall not be wired with sections required for feeder. The incomer panel shall be suitable for receiving bus trunking or MV cable of size specified.

Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous dead front switchboards.

Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

The switchboards shall be designed for use in high ambient temperature and humid tropical conditions as specified. Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

Metal based neoprene gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 43 /IP 54 as stipulated in schedule of items. The unused openings within the switchboards shall be closed using suitable grommets.

Degree of Protection shall be IP54 Up to 2000A and IP43 above 2000A

Other panels where incoming MCCB less than 630A or less should have same minimum busbar size, switchgear compartment volume as there in the type test report of OEM where those MCCB can be in the outgoing.

Degrees of protection provided by enclosures for electrical equipment against mechanical impacts shall be IK10 as per IEC62262, glass door not required.

Special care to be taken to ensure effective earthing of the frame and doors of the switchboards

Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contact with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

Some switchboards may be required to be installed against the wall, for such application-documented designs shall be available.

Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 2 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.

Switchboard shall be provided with "Danger Notice Plate" conforming to relevant Indian Standards.

All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over-load faults with provisions for settings neutral unprotected, neutral protection at 0.5In and neutral protection at 1.0 In to ensure precise neutral protection.

All Breakers in Main LT panel and Incomers of other panel shall be of 4 Pole type with LSIG protection.

Switchboard Dimensional Limitations

The overall height of the switchboard shall be limited to 2400 mm for all the Busbar ratings and type of switchboards. Panel should have integral base frame of 75mm, hence total panel height should not be more than 2475mm.

The height of operating handle, push buttons etc. shall be restricted between 300 mm and 1800 mm from finished floor level.

Other dimensional limits if any are specified separately.

Switchboard Compartmentalization

For compartmentalized switchboards, separate totally enclosed 4B-Compartments shall be provided for horizontal busbars, vertical busbars, ACBs, MCCBs, and cable alleys.

Earthed metal or insulated shutters shall be provided between drawout and fixed portion of the switchgear such that no live parts are accessible with equipment drawn out. Degree of protection within compartments shall **be at least IP 2X**.

Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.

For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.

For Some MCCB feeders for critical loads like UPS it may be required to have operation only after opening the door, all other facilities like padlockable rotary handle to be provided for such feeder. It shall be possible to do this change during execution of order

Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in front of switchgear only.

A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables.

Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley/ cable chamber.

Switchboard Bus Bars

Busbars shall be made of high conductivity, and high strength Aluminum E91 grade Busbars shall be of rectangular cross sections, Busbars shall have current density of 0.66Amp/sq.mm.

The busbars shall be suitable to withstand the stresses of fault level as specified in schedule of items. **Temperature rise limits at busbar should be 65 Deg C on ambient of 50 Deg C. Bus bar temperature monitoring device should be installed at main horizontal, fishplates and vertical busbars for tripping and alarm.**

Main Horizontal busbar and Neutral should be in same compartment.

The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar alloy on either side in which the circuit could be arranged with front access for cable entrances

The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature of 110° C at regular intervals, to withstand the forces arising from a fault level as stipulated in schedule of quantities. **The material and the spacing of the Busbar supports should be same as per the type tested assembly**

Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper. Wires.

Clearances between phases should be in line or more with IEC.

Switchboard Interconnection

All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

All connections, tappings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints. All screws, bolts, washers shall be zinc plated. Only 8.8 grade nuts and bolts shall be used for busbar connections.

Drawout Features

Air Circuit Breakers shall be provided in fully drawout cubicles, unless otherwise stated. These cubicles shall be such that drawout is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

Instrument Accommodation

All voltmeter and ammeter and other instruments shall be flushed mounted type of size 96 sq. mm conforming to class 1.5 to IS 1248 for accuracy. All voltmeter shall be protected with MPCBs.

Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.

For MCCBs, instruments and indicating lamps can be provided on the compartment doors. The current transformers for metering and for protection shall be mounted on the solid copper/ aluminium busbars with proper supports.

On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs.

For Incomer and important outgoing feeders comprehensive power meters shall be provided which shall display A, V, Pf, Hz, Kw, KVA, KVA_r, Kwh, Kvarh, average and maximum values, demand values, THD on current and Voltages. Also add on modules for ethernet port, programmable contacts, analogue output etc. to link to BMS/PLC system

Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 2.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall used at both end of wires. All control wires meant for external connections are to be brought out on a terminal board.

The cables and control wires shall be suitable for withstanding 105 deg C. Space

Heaters

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 50^o C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a general rule, the heaters shall be placed at the bottom of the cubicle.

Earthing

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to station earth at two points. Hinged doors/ frames to be connected to earth through adequately sized flexible braids.

Sheet Steel Treatment and Painting

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50 micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.

Name Plates and Labels

Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

Type test certificate.

Switchboard configurations offered shall be CPRI/ERDA/ Independent international test house tested for all the tests as per IEC-61439-1 and internal arc tests. Copies of the test certificates/reports shall be submitted with the tender.

Testing at Works

Copies of type test carried out at ACB/ MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Engineer-in-Charge reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the followings.

- Physical variation and dimensional check
- Verification of bill of material
- Functional check
- HV test
- IR test

LV Panel Communication general characteristics

The communicating switchboard system comprises:

One or more interfaces

The following information shall be accessible: in accordance with the IEC/EN 60947-5-1 standard for circuit breakers at all the layers of electrical distribution architecture (modular feeders up to incomer circuit breakers): ON/OFF position (O/F)/ trip indication (SD)/ fault-trip indication (SDE).

Cradle management: Draw out position

The following commands shall be possible in accordance with the IEC/EN 60947-5-1 standard

Open/ close/ reset.

When advanced trip units are used the following information shall be accessible:

Instantaneous and demand values, maximum and minimum, energy metering, demand current and power, power quality.

Protection and alarm setting

Time-stamped trip and alarm histories and event tables Maintenance indicators.

Gathering digital and analog inputs and controlling output.

Energy meter in accordance with the IEC/EN – 62053-21 & 31 standard

Interfaces required for Smart Panel

Energy management system shall offer main interface and secondary interfaces for energy management issue. Data shall be collected via Ethernet TCP/IP or ModBus networks which communicating circuit breakers, I/O digital and analog input modules, pulse counter, power meter and energy meter will be connected to interface.

A switchboard display shall be connected via Ethernet TCP/IP or MODBUS network to switchboard interface and shall offer a real time direct data access to monitor and control devices and load.

Ethernet Communication interfaces will be compliant to Device Profile Web Service (DPWS) for discovery on the local area network (LAN).

Energy management interface shall offer direct access to data collection to monitor and control devices and load.

Energy management interface shall collect:

- Data from communicating circuit breaker with embedded measurement capability
- Data from communicating energy meters or power meters

- Logic state of technical devices or equipment
- **Device alarms with time logs**
- Temperature analog sensor value.

Energy management interface shall display via web pages:

- Energy consumption
- **Electrical data network monitoring**
- **Alarms and events**

Energy quality monitoring

Equipment or devices status (open, close, tripped, NA) and indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, Interrupted current.

Operation and predictive maintenance monitoring.

Energy management interface shall integrate simple control functions via web pages:

Load and devices via digital output

Orders of actuator

Technical Specifications Ethernet Gateway

Mounting Din rail

Power supply 24 Vdc

Operating temperature -25 to 70°C

Humidity rating 5 to 95% relative humidity (without condensation) at +55°C Immunity as per EN 61000

Serial ports

RS485 (2-wire or 4-wire), depending on settings, Protocol Modbus RTU/ASCII, Maximum baud rate 38400 or 57600 baud depending on settings

Ethernet port

Type of port 10/100 Base TX (802.3af) port, Protocol HTTP, Modbus TCP/IP, FTP, SNMP (MIB II), BootP

Memory

Memory for logging the custom web pages, Minimum memory of at least.

7. LT SWITCHGEAR

Air Circuit Breakers (ACB)

General

The ACB shall conform to IEC/IS – 60947-2. The ACB shall have a rated service short circuit breaking capacity (Ics) as specified in BOQ "Technical parameters" at rated operational voltage (Ue) at 415V, frequency at 50 Hz. The ultimate breaking capacity (Icu) shall be equal to Service breaking capacity (Ics) and Short Ckt Withstand capacity (Ics=Icu=Icw for 1 sec) rated Impulse withstand voltage (Uimp) shall be 12kv and rated insulation voltage (Ui) at 1000V. The ACB release should have true RMS sensing. The construction of circuit breakers shall be as per **pollution degree 4**.

The breaker shall provide class II insulation between the front panel and internal power circuits to avoid any accidental contact with the live main current carrying path with the front cover open.

Protective devices, metering, CTs, PTs, push buttons and indicating lamps shall be provided as per schedule of quantities.

Constructional Features

The Circuit Breaker shall be flush front, metal clad, horizontal draw-out pattern, three/four pole as required and fully interlocked. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

The Circuit Breaker cradle shall be designed and constructed to permit smooth withdrawal and insertion. The movement shall be free of jerks, easy to operate.

Mechanical Latch or Lock to be provided to identify the Isolated, test & service position of breaker to prevent over racking.

All current carrying parts in the breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts which shall be separate from the main contacts and easily replaceable. In addition, Arc chutes shall be provided for each pole, and these shall be suitable for being lifted out for the inspection of the main and the arcing contacts.

The circuit breaker shall have indication of mechanical wear of contacts enabling visible indication of contact life.

Self-aligning cluster type isolating contacts shall be provided for the Circuit Breaker, with automatically operated shutters to screen live cluster contacts when the Breaker is withdrawn from the cubicle. Sliding connections including those for the auxiliary contacts and control wiring shall also be of the self-aligning type. The fixed portion of the sliding connections shall have easy access for maintenance purposes.

There shall be flexibility in changing the types of terminals at site to suit the bus bar orientation if required.

The frame of the circuit breaker shall be uniform upto minimum 2000 Amps.

The cubicle for housing the Breaker shall be free standing dead front pattern, fabricated from the best quality sheet steel.

There should be minimum clearance of 33mm post termination between the breaker terminals.

Operating Mechanism

The Circuit Breaker shall be trip free with independent manual spring operated or motor wound spring operated mechanism as specified and with mechanical ON/OFF indication. The operating mechanism shall be such that the circuit breaker is at all times free to open immediately the trip coil is energised. The breaker shall be provided with in antipumping mechanism.

The closing time shall be less than or equal to 70 ms to ensure faster closing of the breaker. And tripping time should be less than 30 ms to reduce the let through energy in the event of fault.

The operating handle and mechanical trip push button shall be at the front of and integral with the Circuit Breaker.

ACB shall have a Ready to close mechanism preferably having a ready to close mechanical indication on front of ACB. after checking all the given conditions (UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not tripped on fault, Breaker is not mechanically interlocked with other breaker and ACB is not racked in completely in-service position) ensuring safety for user and electrical distribution.

There shall be mechanical or electrical indicator on the front panel for 'Ready to close' situation for the breaker by checking all interlockings.

The Circuit Breaker shall have the following three distinct and separate positions which shall be indicated on the face of the panel. The breaker shall get latched in each of three position namely Service, Test and Isolated, operator to de latch or unlock before racking in/out to other position

"Service" -- Both main and secondary isolating contacts closed

"Test" -- Main isolating contacts open and secondary isolating contacts closed o "Isolated"

-- Both main and secondary isolating contacts open

Circuit Breaker Interlocking

Sequence type strain free interlocks shall be provided to ensure the following:

It shall not be possible for the Breaker to be withdrawn from the cubicle when in the "ON" position. To achieve this, suitable mechanism shall be provided to lock the Breaker in the tripped position before the Breaker is isolated.

- It shall not be possible for the Breaker to be switched "ON" until it is either in the fully inserted position or, for testing purposes, it is in the fully isolated position.
- It shall not be possible for the breaker to be switched "ON" arc chutes are not fully inserted.
- It shall not be possible for the Circuit Breaker to be plugged in unless it is in the OFF position.
- Arc Chute interlocking, breaker should not operate if arc chutes are not properly fixed.
- A safety latch or locking arrangement shall be provided to ensure that the movement of the Breaker, as it is withdrawn, is checked before it is completely out of the cubicle, thus preventing its accidental fall due to its weight.
- Mechanical and electrical antipumping devices shall be incorporated in the ACB's as required.

Circuit Breaker Auxiliary Contacts

The Circuit Breaker shall have suitable free/ minimum 4 NO/NC auxiliary contacts rated at 10 amps 415 volts 50 Hz. These contacts shall be approachable from the front for connecting all external wiring from the front. They shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is Drawn Out of the cubicle.

Electrical Auxiliaries

- All electrical auxiliaries, including the spring charging gear motor shall be instalable on site without requiring adjustment or any tools other than a screw driver
- The auxiliaries shall be placed in a compartment which under normal operating conditions, shall not contain any conducting parts capable of entering into electrical contact with the circuit breaker poles. It shall be possible to connect all auxiliary wiring from the front of the circuit breaker.

Circuit breaker Releases

The Air Circuit Breakers should have microprocessor release.

The Incoming circuit breaker to be equipped with the microprocessor based release with adjustable short circuit protection with adjustable time delay, Over current protection, and adjustable earth fault protection with adjustable time delay. Circuit breaker trip unit shall have a display for measurement and protection of current, voltage, power factor and energy. temperature rise protection and alarms at the terminals. It shall be possible to view last 20 trip cause on trip unit with real date and time stamping along with interrupted value.

ACB should have thermal Memory and Zone selective interlocking for logic discrimination to reduce thermal/electrodynamics stresses in the event of short circuit and earth fault.

The outgoing ACBs should have microprocessor-based Release with Short circuit and overload protections with Display of current. Percentage loading values of all the three phases of the breaker to be available on the release.

On line setting of the parameters should be possible.

The setting of the ACB should be possible digitally as well as with dial / keypad settings with the help of screwdriver.

Option of communication port on all types of the releases, even if the same is not specified at the time of ordering.

As an option it should be possible to have programmable contacts if required at later date.

Separately powered, individual fault trip indication LEDs (For overload, short circuit, earth fault and trip unit failure shall be available on the trip unit which shall function even if the display fails.

COMMUNICATION:

The advanced communication system/ release simulation test kit needed for the project shall be able to show the basic data inside the trip unit of the ACB without using any external software. This is required for two purposes

- a) Communication testing of the circuit breakers at panel builder's shop floor and generating the communication check report
- b) Basic parameters (A, V, kWh, no. of operations etc.) viewing on Ethernet/Modbus RS485 network from anywhere in LAN network and from any laptop, computer or smart phone.

- c) Easy replacement of the Ethernet modules without the involvement of system integrators, in case the modules become faulty.

Specifications for communication

All ACBs shall be provided with individual Modbus TCP Ethernet/Modbus RS485 ports modules for better speed of data transfer and connected to PLC for following.

One display module/HMI or Breaker release for each circuit breaker, shall be able to provide following information's. It shall contain the following information about circuit breakers.

- a) Metering data.
- b) Circuit breaker load profile
- c) Circuit breaker number of ON/OFF operations and number of trip operations counter
- d) It shall be possible to control the circuit breaker from the module

Panel builder shall provide circuit break communication test report having the following data

- a) Circuit breaker communication check (Ok/Not Ok)
- b) Circuit breaker settings at the time of communication test. Settings on the circuit breaker, at the time of communication test, shall be same as recommended by the consultant.

One energy data logger with below features/accessories shall be provided for the project

- a) Modbus RS485 and Modbus TCP ports
- b) Analog and Digital inputs
- c) It shall be able to take the data from all Modbus RS485 or Modbus TCP meters, ACB Ethernet/Modbus RS485 modules, MCCB Ethernet/ Modbus RS485 modules etc. and display on its webpage/PLC/BMS and store the entire data in its memory

Each Incoming ACB release shall be accessible via browser to view the following

- a) Current, voltage and energy data measurement and protection
- b) Circuit breaker number of operation measurement
- c) Circuit breaker control (ON/OFF)
- d) Email notifications for undesired events like circuit breaker tripping on electrical fault, circuit breaker tripping on overload/short circuit/earth fault/trip unit failure etc. through PLC/BMS.
- e) It shall be possible to send the energy consumption daily reports by Email or FTP directly from inbuilt web-pages or PLC.
- f) Circuit breaker ready to close and spring charge status
- g) Circuit breaker settings
- h) Circuit breaker last 20 trip and event history

Earthing

The frame of the Circuit Breaker shall be positively earthed when the Circuit Breaker is racked into the cubicle.

MOULDED CASE CIRCUIT BREAKERS (MCCB)

General

The Molded case circuit Breaker (MCCB) shall conform to the latest IEC 60947-2 and IEC 947-3-1989. MCCB's shall be suitable for rated operation voltage up to 415 VAC & rated insulation voltage up to 800VAC.

MCCB's in AC circuits shall be of triple pole / four pole construction as per enclosed BOQ. Operating mechanism shall be Double break quick-make, quick-break and trip-free type. The "ON", "OFF" and "TRIP" positions of the MCCB's shall be clearly indicated and visible to the operator when mounted as in service. Front of door operating handle shall be provided with pad lock and door interlock. Front of door operating handle shall be provided with door interlock defeat mechanism to facilitate inspection of the MCCB during 'ON' position. MCCB shall be suitable for Positive isolation / disconnection according to IEC 60947-1 & 2 for optimum user safety.

The Service short circuit Breaking capacity (Ics at 415 VAC) of all MCCB's shall be as specified in BOQ and shall have (Ics=100% Icu).

All MCCB should have "Class-II" front facia.

Construction, operation, environment

For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting.

All poles shall operate simultaneously for circuit breaker opening, closing and tripping.

MCCBs shall be actuated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED.

In order to ensure suitability for isolation complying with IEC 60947-2 § 7-27:

- The operating mechanism shall be designed such that the toggle or handle can only be in OFF position (O) if the power contacts are all actually separated,
- In OFF position, the toggle or handle shall indicate the isolation position. Isolation shall be provided by a double break on the main circuit.

MCCBs shall be equipped with a "push to trip" button in front to test operation and the opening of the poles.

MCCB rating, "push to trip" button, performances and contact position indication must be clearly visible and accessible from the front, through the front panel or the door of the switchboard.

MCCBs shall have cross bolted or allen bolts with phase barriers with shrouded terminals to withstand thermodynamic stress at higher short circuit current.

Discrimination, Durability

MCCBs shall be capable of greatly limiting currents. For short-circuits, the maximum thermal stress I^2t shall be limited.

The electrical durability of MCCBs, as defined by IEC 60947-2 standard, shall be at least equal to 3 times the minimum required by the standard.

MCCBs shall be equipped with a self-test or test with help of test kit of the connection between the electronic trip unit, the current transformers and the actuator.

Having double break contacts for minimum let through energy and better current limitation

Auxiliaries and Accessories

It shall be possible to equip MCCBs with a motor mechanism for electrically controlled operation. An "auto/manual" switch in front shall, when set to the "manual" position, lock out electrical control; when set to "auto", lock out the manual control; remote indication of "manual" or "auto" mode shall be possible. It shall also be possible to seal the access to the "auto" control.

Following tripping due to electrical faults (overload, short-circuit, earth fault), remote reset shall be inhibited.

It shall however be possible if opening was initiated by a voltage release.

The operating mechanism shall be of the stored-energy type only

The addition of a motor mechanism or a rotary handle shall in no way affect circuit breaker characteristics:

- only three stable tripping mechanism positions (ON, OFF and TRIPPED) shall be possible with the motor mechanism,
- Suitability for isolation shall be provided by positive contact indication (ON and OFF) in front of the motor mechanism module

MCCBs shall be designed to enable safe on-site installation of auxiliaries such as voltage releases (shunt and under voltage releases) and indication switches as follows:

- they shall be separated from power circuits,
- all electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks,
- all auxiliaries shall be common for the as per frame size.
- Auxiliary function and terminals shall be permanently engraved on the case of the circuit breaker and the auxiliary itself,
- The addition of auxiliaries shall not increase the volume of the circuit breaker.
- Electrical fault trip contact and indication.

The addition of a motor mechanism module or a rotary handle, etc., shall not mask or block device settings.

Protection functions

General recommendations

Electronic and thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorized access to the settings

Electronic trip units shall comply with appendix F of IEC 60947-2 standard (measurement of rms current values, electromagnetic compatibility, etc.)

Protection settings shall apply to all circuit breaker poles

The trip units shall not augment overall circuit breaker volume

All electronic components shall withstand temperatures up to 85.

Thermal-magnetic trip units (up to 250 A)

Characteristics:

- Adjustable thermal protection from 0.7 to 1.0 times the current rating
- Adjustable magnetic protection for current ratings up to 200 A
- Adjustable (from 5 to 10 times the current rating) for current ratings greater than 200 A.

It shall be possible to ensure neutral protection. The tripping threshold shall be equal to that of the phases or to a reduced value (generally half of that of the phases).

Microprocessor trip units (above 250 A)

Characteristics

- Long time protection (LT)

Selectable Ir threshold settings from 30% to 100 % of the trip unit rating

- Short time protection (ST)

Isd threshold shall be adjustable from 1,5 to 10 times the thermal setting Ir, The time delay shall be either adjustable or fixed at 40 ms, - Instantaneous protection
The threshold shall be either adjustable or fixed (starting from 1.5 times In and up to a value between 11 and 15 times In, depending on the rating)
Earth fault setting from 0.2 to 0.7 In.
Switchable thermal Memory, Earth fault and short circuit time delay 100ms/200ms respectively.

Communication

MCCB should have option for communication in the Main LT Panel for critical feeders.

Load monitoring function

The following monitoring functions shall be integral parts of electronic trip units:

Individual LED for fault identification on Over Load, Short Circuit, Earth Fault and Instantaneous.

Thermal memory

All the MCCBs should have thermal memory feature.

In the event of repeated overloads, the electronic trip unit shall optimize protection of cables and downstream devices by memorizing temperature variations & temperature module can be added to give alarm and tripping.

Multi-Function Meters

Meters for Main LT Panel

Power Meter Specifications

The present specification applies to power meter devices from 110V to 690V direct connect or up to 1MV with potential transformers in different system configurations from single phase to three phase AC (50/60Hz).

The Power meters with following features shall be included as part of this project and identified on the single-line drawings:

Basic level Monitoring with the features to include energy, demand, power, harmonics, 3 current transformer inputs and real time battery backed

Serial communication, 8-rate multi tariff, up to 15th Individual harmonics, 1 digital outputs & total of 33 alarms events.

Compliance to Standards

ANSI: ANSI C12.20

European Standards: EN 50470-1, EN 55011

Federal Communications Commission: FCC 47 CFR Part 15

IEC: IEC 61000-3-2, 61000-3-3, 61000-3-4, 61000-3-5, 61000-3-6, 61000-3-8, 61000-3-11, IEC 61010-1, IEC 61557-12, IEC 62052-11, IEC 62053-22, IEC 62053-23,

ISO: ISO 9001, ISO 14001, ISO 14062

Underwriters Laboratories, Inc: UL 61010-1

Power meter design

General Provisions– Common Features

The power meter may be applied in single phase, three-phase, three- or four-wire systems in WYE or Delta mode and shall be capable of being applied without modification at nominal frequencies of 50 or 60Hz.

The power meter shall have a **real time clock with battery back-up** with at least 1 year ride through time without external power.

Mechanical

The power meter unit shall have removable connectors for voltage inputs, control power, communications, input and outputs.

The power meter unit shall be easily mounted in the pre-made cut-out without tools. Power meter form factor shall be ¼ DIN with 92 x 92 mm (3.622" x 3.622") cut-out and 96 x 96 mm (3.78" x 3.78") panel mount integrated display.

Sampling and Harmonic Resolution

The current and voltage signals shall be digitally sampled at a rate high enough to provide true rms accuracy to the 15th harmonic (fundamental of 50/60 Hz). The circuit monitor shall provide continuous sampling at a minimum of up to 64 samples/cycle simultaneously on all voltage and current channels in the meter.

Current Inputs

0-10 amps with 5 amps nominal input from CT secondary.
The power meter may be applied in three-phase, three- or four-wire systems.
Residual current shall be calculated by vectorial addition of the phase currents.

Voltage Inputs

Nominal of 400 V L-N / 690 V L-L.
Maximum of 480 V L-N / 828 V L-L.

Control Power (Device)

The monitoring device control power shall be:
100-415 VAC L-N ±10% or 125-250 ± 20% VDC.

Environmental Characteristics

Operating Temperature Range of meter: 25 to 70 °C (-13 to 158 °F), display -20 to 70 °C (-4 to 158 °F)

Accuracy

The power meter unit shall use four-quadrant metering. The power meter shall sample current and voltage simultaneously without gaps with 64 samples per cycle (zero blind)
The power meter device shall comply with ANSI C12.20 Class 0.5 and IEC 61557-12 Class 0.5 for revenue meters
Accuracy for Active energy of the power meter shall be class 0.5S as per IEC 62053-22
Accuracy for reactive energy of the power meter shall be class 2S as per IEC 62053-24 (reactive energy)
No annual calibration shall be required to maintain this accuracy.

Input /Output

The power meter shall support 1 solid state output.

Energy quantities

Cumulative quantities for real, reactive and apparent energies shall be stored in non-volatile memory.
The power meter shall allow pre-setting of the energy quantity at any value within the register range via communications, to match a unit being replaced in the field.
The power meter shall provide the user the ability to reset the cumulative energy quantities from the display of the unit or via communications.

Alarm events shall be user definable.

Setpoint driven alarm events shall be available for voltage/current parameters, input status, and end of interval status. For each over/under metered value alarm, the user shall be able to define a pick-up, drop-out, and delay

The power meter shall have a minimum of 28 set-point driven alarms

There shall be four alarm severity levels in order to make it easier for the user to respond to the most important events first.

Historical alarms shall have a time stamping with 1 second accuracy. The meter's real time clock shall be able to synchronize using communications command.

Indication of an alarm condition shall be given on the front panel.

Communications

The power meter shall communicate via serial RS-485 Modbus or Jbus protocol.

Display

The power meter display shall be backlit dot-matrix LCD for easy viewing, display shall also be anti-glare and scratch resistant with a minimum of 128x128 pixels. (PM Device)

The power meter display shall be capable of allowing the user to view four values on one screen at the same time. A summary screen shall also be available to allow the user to view a snapshot of the system. (PM Device)

The power meter display shall allow the user to select a date/time format.

The power meter display shall allow configuration for IEC or IEEE visualization of quantities.

Firmware Upgrade

It shall be possible to field upgrade the firmware in the power meters to enhance functionality. These firmware upgrades shall be done through the Ethernet or serial communication connection and shall allow upgrades of individual meters or groups.

Measured Values

The power meters shall provide the following, true RMS metered quantities. In addition, the power meters shall record and save in nonvolatile memory the minimum and maximum values of all listed values since last reset. The power meters shall also record and save in nonvolatile memory the interval minimum, maximum, and average of any of the values pre-defined over a user specified interval

Current (Per-phase, 3-Phase Avg, % Unbalanced)

Neutral and Ground (4CTs)

Voltage (L-L Per-phase, L-L 3-Phase Avg, L-N Per-Phase, 3-Phase Avg, % Unbalanced)

Real Power (Per-phase, 3-Phase Total)

Reactive Power (Per-phase, 3-Phase Total)

Apparent Power (Per-phase, 3-Phase Total)

Power Factor (True/Displacement) (Per-phase, 3-Phase Total)

Frequency

THD, thd, TDD (Current and Voltage), Individual harmonics up to the order of 15th

Energy Readings

Accumulated Energy (Real kWh, Reactive kVARh, Apparent kVAh) (Signed/Absolute)

Active Energy Delivered for 4 independent rates

Reactive Energy Delivered for 4 independent rates in

Demand Readings

Demand Current Calculations (Per-Phase, 3-Phase Avg, Neutral) - Present and Peak

Real Power

Reactive Power

Apparent Power

All power demand calculations shall use any one of the following calculation methods, selectable by the user:

Thermal demand using a sliding window technique.

Block interval, with optional sub-intervals. Block methods available are Sliding, Fixed and Rolling.

Demand can be calculated using a Synchronization signal:

Demand can be synchronized to an input pulse from an external source.

Demand can be synchronized to a communication signal.

Demand can be synchronized to the clock in the power meter

Power Analysis Values

THD, thd – Voltage, Current (3-Phase, Per-phase)

Power Factor (Per-phase, 3-Phase)

Displacement Power Factor (Per-phase, 3-Phase)

Fundamental Voltage, Magnitude and Angle (Per-phase)

Fundamental Currents, Magnitude and Angle (Per-phase)

Fundamental Real Power (Per-phase, 3-Phase)
Fundamental Reactive Power (Per-phase)
Harmonic Power (Per-phase, 3-Phase)
Unbalance (Current and Voltage)
Harmonic Magnitudes (Per-phase)
Total Demand distortion factor (TDD)

Miniature Circuit Breaker (MCB)

Miniature circuit breakers shall be of approved design and make and must be tested and validated as per IS/IEC 60898, IEC/EN 60898 and IEC 60947-2 standards.

MCBs shall be suitable for operation at 230V/415V, 50Hz supply. The MCB ratings shall be available from 1--125A in 1P/2P/3P/4P versions. The rated short circuit capacity acc to IS/IEC 60898 shall be of 10,000A. MCBs shall be offered with B, C or D tripping characteristics as per the BOQ requirements. The MCBs shall be suitable for mounting on a 35mm DIN rail.

MCBs shall carry ISI and CE marking. The MCB manufacturer (through the bidder) has to submit the valid BIS license certificate at the time of offer submission.

MCBs shall ensure complete electrical Isolation of downstream circuit or equipment, when the MCB is switched OFF **(to be marked on the MCB in symbolic form)**, **There should be clear identification of flag indication on MCB tripping reason for Overload current and Short Circuit tripping on each pole**

IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Energy Limitation Class-3 shall be to ensure minimum let through energy in the event of a fault, for safety & longevity of downstream circuit equipment. **(to be mentioned on the MCB as per standards)**

MCBs shall be line-load reversible with no derating.

MCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings up to 25A, and 35 sq.mm. for ratings 32A & above to ensure perfect termination of wires and cables. Terminals of MCBs shall have captive screws.

Basic technical parameters, rating, operating voltage, energy limiting class 3 etc. shall be printed on front face of MCB for ease of identification.

The devices must be capable of heavy-duty operation and to that end, the manufacturer shall guarantee the following performance levels, defined by IEC / EN 60947-2 standards:
suitability for isolation (section 7.2.7)
rated insulation voltage (section 4.3.1.2): 500 V
pollution degree (Part 1, section 6.1.3.2): 3
rated impulse-withstand voltage (section 4.3.1.3): 6 kV
Discrimination for power continuity
Validated Cascading tables as per standard IEC 60947-2

Operating knob shall have provision to lock in ON / OFF condition without affecting any automatic tripping

Circuit-breakers shall be capable of operation under ambient temperature up to **50 °C**, **without derating** of their overload tripping threshold with respect to their rated operating current. The same must be tested and validated as per IEC 60947-2 standard.

The material used to manufacture MCB shall be 100% recyclable and must comply to **RoHS**.

MCBs shall be suitable for field-fittable Protection auxiliaries (viz. Over-voltage release, Under-voltage release, Shunt trip) and Indication Auxiliaries (like Auxiliary Contact, Trip alarm contact).

MCBs shall be upgraded on communication (On/Off/Trip) at site by adding communication capable auxiliaries and communication can be over RS485 or Ethernet i.e.TCP/IP through Ethernet gateway.

Motor Control & Protection

There should be total coordination between MPCB, Overload relay & Contactor.

Totally coordinated starter up to 15KW as per IEC 60947-6-2, starter module should have breaking capacity of 50kA at 480V, which can be increased up to 100kA. Overload and Short circuit fault discrimination should be available on power base of starter module. DOL starter should be available in 45 m width. All 5 starter functions should be available in single module of 154*45mm. Starter module should be modular type to adopt late customization of function. Starter Module should have facility of current base protection, monitoring and control of motor feeder. Low consumption coils should be available in wide voltage band selection from 24V -220V AC/DC.

Wide operational ambient temperature of -25°C to +60°C. Electrical life of starter module as per AC3 should be 2.1 million operations.

8. AUTOMATIC TRANSFER SWITCHES

GENERAL

Scope

Furnish and install automatic transfer switches (ATS) with number of poles, amperage, voltage, and withstand current ratings as shown on the plans. Each automatic transfer shall consist of a mechanically held power transfer switch unit and a microprocessor controller, interconnected to provide complete automatic operation. All transfer switches and control panels shall be the product of the same manufacturer.

Codes and Standards

The automatic transfer switches and accessories shall conform to the requirements of:

- A.** UL 1008 - Standard for Automatic Transfer Switches
- B.** CSA C22.2 No.178 – 1978
- C.** NFPA 70 - National Electrical Code
- D.** NFPA 99 – Health Care Facilities
- E.** NFPA 110 - Emergency and Standby Power Systems
- F.** IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
- G.** NEMA Standard ICS10-2005 (formerly ICS2-447) - AC Automatic Transfer Switches
- H.** NEC Articles 700, 701, 702
- I.** International Standards Organization ISO 9001: 2008
- J.** IEC 60947 – 6 – 1

PRODUCTS

Mechanically Held Transfer Switch

- A.** The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include over current disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
- B.** The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
- C.** All main contacts shall be silver composition. Switches rated 800 amperes and above shall have segmented blow-on construction for high withstand current capability and be protected by separate arcing contacts.
- D.** Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.
- E.** Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
- F.** Where neutral conductors must be switched, the ATS shall be provided with fully-rated neutral transfer contacts.
- G.** Where neutral conductors are to be solidly connected, a neutral terminal plate with fully-rated AL-CU pressure connectors shall be provided.

Group 'G' Controller with Integrated User Interface Panel

- A.** The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
- B.** The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, inherent serial communications capability, and the ability to communicate via the Ethernet through optional communications module
- C.** A single controller shall provide single and three phase capability for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.1\text{Hz}$. Time delay settings shall be accurate to $\pm 0.5\%$ of the full scale value of the time delay. The panel shall be capable of operating over a temperature range of -20 to $+ 70$ degrees C, and storage from -55 to $+ 85$ degrees C.
- D.** The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on printed circuit boards.
- E.** The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

1. IEC 60947 – 6 – 1 Multiple Function Equipment Transfer Switching Equipment.
61000-4 Testing And Measurement Techniques - Overview
 - a. IEC 61000 – 4 - 2 Electrostatic Discharge
Immunity
 - b. IEC 61000 – 4 - 3 Radiated RF Field Immunity
 - c. IEC 61000 – 4 - 4 Electrical Fast Transient/Burst Immunity
 - d. IEC 61000 – 4 - 5 Surge Immunity
 - e. IEC 61000 – 4 – 6 Conducted RF Immunity
2. CISPR 11 – Conducted RF Emissions and Radiated RF Emissions

Enclosure

- A. The ATS shall be furnished in a NEMA type 1 enclosure unless otherwise shown on the plans.
- B. Provide strip heater with thermostat for Type 3R enclosure requirements.
- C. Controller shall be mounted on, visible, and operational through enclosure door.

OPERATIONS

Controller Display and Keypad

- A. A 128*64 graphical LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through communications port. The following parameters shall only be adjustable via DIP switches on the controller.

1. Nominal line voltage and frequency
2. Single or three phase sensing on normal
3. Transfer operating mode configuration, (open transition, or delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

Voltage and Frequency Sensing

- A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip settings capabilities (values shown as % of nominal unless otherwise specified).

<u>Parameter</u>	<u>Sources</u>	<u>Dropout/Trip</u>	<u>Pickup/Reset</u>
Undervoltage	N & E	70 to 98%	85 to 100%
Overvoltage	N & E	102 to 116%	2% below trip
Under frequency	N & E	85 to 98%	86 to 100%
Over frequency	N & E	101 to 111%	2% below trip

- B. Repetitive accuracy of all settings shall be within 1% at +25C
- C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- D. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage and frequency. *Note: Single phase sensing on emergency*

- E. The backlit 128*64 graphical display shall have multiple language capability. Languages can be selected from the user interface.

Time Delays

- A. A time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals, adjustable 0 to 6 seconds. It shall be possible to bypass the time delay from the controller user interface.
- B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes 59 seconds for controlled timing of transfer of loads to emergency. It shall be possible to bypass the time delay from the controller user interface.
- C. A generator stabilization time delay shall be provided after transfer to emergency adjustable 0 or 4 seconds.
- D. A time delay shall be provided on retransfer to normal, adjustable 0 to 9 hours 59 minutes 59 seconds. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
- E. A cooldown time delay shall be provided on shutdown of engine generator, Adjustable 0 to 60 minutes 59 seconds.
- F. All adjustable time delays shall be field adjustable without the use of special tools.
- G. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minutes 59 seconds time delay in any of the following modes:
 - 1. Prior to transfer only.
 - 2. Prior to and after transfer.
 - 3. Normal to emergency only.
 - 4. Emergency to normal only.
 - 5. Normal to emergency and emergency to normal.
 - 6. All transfer conditions or only when both sources are available.
- H. In the event that the alternate source is not accepted within the configured Failure to Accept time delay, the common alert indication shall become active.
- I. The controller shall also include the following built-in time delay for delayed transition operation.
 - 1. A time delay for the load disconnect position for delayed transition operation adjustable 0 to 5 minutes 59 seconds.

Additional Features

- A. The user interface shall be provided with test/reset modes. The test mode will simulate a normal source failure. The reset mode shall bypass the time delays on either transfer to emergency or retransfer to normal.

- B. A set of contacts rated 5 amps, 30 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down. setting, regardless of whether the normal source restores before the load is transferred.
- C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed when the ATS is connected to the emergency source.
- D. A single alarm indication shall light up the alert indicator and de – energize the configured common alarm output relay for external monitoring.
- E. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
- F. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency (red) source, as determined by the voltage sensing trip and reset settings for each source.
- G. LED indicating light shall be provided to indicate switch not in automatic mode (manual); and blinking (amber) to indicate transfer inhibit.
- H. LED indicating light shall be provided to indicate any alarm condition or active time delay (red).

The following features shall be built – in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:

- I. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
- J. A variable window in phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in phase monitor shall be specifically designed for and be the product of the ATS manufacturer.
- K. An engine generator exercising timer shall be provided to configure weekly and bi-weekly automatic testing of an engine generator set with or without load for 20 minutes fixed. It shall be capable of being configured to indicate a day of the week, and time weekly testing should occur.

The following feature shall be built – into the controller, but capable of being activated through keypad programming, communications interface port, or additional hardware.

- L. Terminals shall be provided for a remote contact to signal the ATS to transfer to emergency. This inhibit signal can be enabled through the keypad or serial port.
- M. System Status - The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key. This screen shall display a clear description of the active operating sequences and switch position. For example,

Normal Failed

**Load on Normal
TD Normal to Emerg
2min15s**

Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual are not permissible.

- N.** Self Diagnostics – The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
- O.** Communications Interface – The controller shall be capable of interfacing, through an optional serial communication port with a network of transfer switches, locally (up to 4000 ft.). Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control, and setup of parameters.
- P.** Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non – volatile memory.
 - 1. Event Logging
 - 1. Data and time and reason for transfer normal to emergency
 - 2. Data and time and reason for transfer emergency to normal
 - 3. Data and time and reason for engine start
 - 4. Data and time engine stopped
 - 5. Data and time emergency source available
 - 6. Data and time emergency source not available
 - 2. Statistical Data
 - 1. Total number of transfers
 - 2. Total number of transfers due to source failure
 - 3. Total number of day’s controller is energized
 - 4. Total number of hours both normal and emergency sources are Available
 - 5. Total time load is connected to normal
 - 6. Total time load is connected to emergency
 - 7. Last engine start
 - 8. Last engine start up time
 - 9. Input and output status

ADDITIONAL REQUIREMENTS

Withstand and Closing Ratings

- A.** The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans. WCR ATS ratings shall be as follows when used with specific circuit breakers:

ATS Size	Withstand & Closing Rating MCCB (480v/60hz)	W/CLF
30	22,000A	100,000

70 - 200	22,000A	200,000
230	25,000A	100,000
260 - 400	42,000A	200,000
600	50,000A	200,000
800 - 1200	65,000A	200,000
1600 - 2000	85,000A	200,000
2600 - 3000	100,000A	200,000

Tests and Certification

- A.** The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- B.** Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- C.** The ATS manufacturer shall be certified to ISO 9001:2008 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design /development, production, installation and servicing in accordance with ISO 9001: 2008.

Service Representation

- A.** The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
- B.** The manufacturer shall maintain records of switch shipments, by serial number, for a minimum of 20 years.
- C.** For ease of maintenance, the transfer switch nameplate shall include drawing numbers and serviceable part numbers.

9. HYBRID POWER FACTOR CORRECTION PANEL

SCOPE

Assembly/ fabrication, installation, testing and commissioning of 3 phase, 440 V, 50 Hz TP&N PFC system (Auto + manual option) with Super Heavy Duty type capacitors, microprocessor based controller and Copper wound detuned filter. The unit shall improve the monthly average power factor and mitigate harmonic distortion on the LV bus.

ENCLOSURE

The panel shall be indoor type, free standing, and floor mounting with IP42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure with angle supports as necessary and shall be finished with powder coating in the approved colour shade/s to match the colour of the other panels. The thickness of powder coating should be minimum 60-80 microns.

Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided as a necessary.

The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors. The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

There should be compliance for the following:

IS16636/ IEC61921: Power capacitors–Low voltage power factor correction banks.

IEC 61439-1 : Low-Voltage Switchgear and Control gear Assemblies - Part 1: Type- Tested and Partially Type-Tested Assemblies.

IEC 62208 : Empty enclosures for low-voltage switchgear and control gear assemblies – General requirements

IEC 62262 : Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

IEC 61326-1 : Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements.

IEC 61000-6-4 : Electromagnetic compatibility – Generic standards – Emission standard for industrial environments

HPFC PANEL OPERATION:

The HPFC panel shall, in its default configuration, shall implement the following features through Separate controller for controlling switching of Passive & Active devices controller. The controller shall ensure that the reactive current requirement of the base load shall be drawn through the capacitors and the additional requirement shall be automatically catered through active filter ensuring step less compensation of reactive current. The entire system should function like a single unit delivering complete benefits to the end customer with respect to the below mentioned parameters:

- a) Step-less Power Factor Correction (for both leading and lagging current), Control response time : 80 μ s
- b) Harmonics Compensation up to 50th order
- c) Load Current Balancing in the three phases

THE HPFC PANEL SHALL COMPRISE:

Incomer

A suitably sized as indicated in GFC drawing three pole MCCB or ACB having microprocessor based over-current and short-circuit protection and at least 50kA breaking capacity (100% Ics) as the incomer of the panel.

Metering and Indication

- a) R, Y, B indication lights for the incomer ACB/ MCCB
- b) On, Off & Trip indication lights for the incomer ACB/ MCCB
- c) A digital multifunction meter showing voltage, current, frequency, PF, THD, kW, kVA, and other related parameters
- d) Three number of cast resin CTs of suitable rating
- e) One number of three phase digital ammeter showing current in three phases of HPFC panel

An active filter part and a passive filter part; the ratio of the rating of active filter to that of the passive filter shall be at least 1:1

The exact distribution of total capacity between the active and passive part shall depend on the rating of the HPFC panel. It is required 400 - 600 Amps IGBT based active power

filter and 600 kVAR detuned capacitor banks integrated together through a single controller to achieve hybrid power factor correction system.

ACTIVE POWER FILTER

The Active Power Filter (Type APF) is intended to remove harmonic distortion from the phase conductors in a 3-phase electrical system resulting in reduced phase current, reduced current distortion and reduced upstream electrical system harmonic voltage distortion.

PRINCIPLE OF OPERATION

APF should measure level of harmonics in supply line and eliminate it by generating the counter harmonics. It should employ a DSP which determines the harmonic current amplitude to be injected in the opposite phase angle of each harmonic order. Along with harmonic compensation, it should be able to take care of power factor (lead and lag) and unbalance correction at the point of connection.

The active filter shall not only provide harmonic mitigation, but also, power factor correction and load balancing. Harmonic correction, PF correction and Unbalance correction should be able to set with priority.

- a) The active harmonic filter shall mitigate harmonics from the 2nd harmonic up to the 50th harmonic and limit harmonic distortion at their point of connection to within the harmonic limits specified herein. The active filter shall be connected in parallel (shunt) to the load.
- b) The active filter shall be suitable for connection at an electrical distribution panel, transformer secondary or at an individual load.
- c) The active filter shall be suitable for connection to a distorted voltage source and its operation shall not be adversely affected by pre-existing voltage distortion.
- d) The active filter shall be suitable for operation on an electrical system having a generator as its power source.
- e) AHF should have high attenuation greater than 96% of individual harmonics
- f) AHF shall allow selection of any 20 order of harmonics out off 2nd to 50th harmonics order.
- g) It should be possible to use filter for single harmonic elimination
- h) PF compensation should be leading as well as lagging
- i) APF should be capable of unbalance correction

ESSENTIAL REQUIREMENTS FOR THE POINT OF RELIABILITY

- a. For capacities above 200 Amp onwards the filter design should adapt modular construction
- b. The display should be Touch screen SVGA display with true RMS values. The wave form should be visible on the display.
- c. High grade cooling blowers shall be used.
- d. In case of future repair requirements, the same shall be done through card level replacement and not the whole module

ELECTRICAL RATINGS:

- a) System Voltage: 415V AC \pm 10%, 3ph 4 Wire/3 wire
- b) Line voltage tolerance: \pm 10%
- c) System Frequency: 50 Hz
- d) Frequency tolerance: 50 Hz \pm 5%
- e) Harmonic Cancellation Current: [30, 60, 75,100, 150, 200, 300, 400, 600, 800 amps].

Multiple filter units for parallel connection may be used to achieve total current requirements for combined power factor correction and harmonic mitigation.

- a) Possible units of same ratings connected in parallel: Infinite.
- b) Current transformers shall be with Class 0.5 or better with 15VA rating.
- c) Flexibility to select CT ratio shall be also be available.
- d) Surge withstand capability per ANSI/IEEE STD C62.41-1991.
- e) Should comply with IEC/IEEE 62040 – 2 category C3.
- f) The Active harmonic filter shall be of certified design confirming to IEC 60529, CE
- g) EMC Certification IEC/EN 61439-1, As per International Standard: cULus (UL508, CSA 22.2 No. 14), CE Certified, ABS,CE EMC Certification IEC/EN 60439-1, EN 61000-6-4 Class A, EN
- h) 61000-6-2, Seismic rating: Complies with IBC and ASCE7

2 – BASIC PRODUCT REQUIREMENTS

The active harmonic filter shall meet the following basic requirements:

- a) Active filters shall include input surge suppression.
- b) Active filters shall include forced air cooling system.
- c) Active filter shall be able to connect in both open loop and closed loop configuration
- d) Active filter should have a HMI touch screen display having the functionality of a power analyzer and should display parameters as mentioned below
 - i. Current Parameters: Arms, A1rms, iTHD (%), Aunb
 - ii. Voltage Parameters: Vrms, V1rms, Urms, vTHD (%), Vunb, Frequency
 - iii. Power Parameters: Active, Reactive, Apparent Power
 - iv. Power Factor
 - v. Displacement Power Factor
 - vi. Filter Parameters: Apk, Filter Utilization, Stack Temperature, DC Voltage, Filter Runtime, Fan Runtime, Panel Temperature
 - vii. Voltage and current waveforms
 - viii. Voltage and current Harmonic spectrum
 - ix. Alarm indications & log details
 - a) Product warranty period shall be 24 months..
 - b) Active filter shall be isolated from the power supply when powered "off".
 - c) IGBT modules shall be self-protected for maximum reliability.
 - d) The response time shall be at least 80µs and the correction time shall be less than 10 ms
 - e) AHF shall have auto fold back feature.

Construction:

- a) Constructed on metal panel with minimum IP 20.
- b) Filter shall be suitable for operation upto an ambient temperature 45°C with suitable ventilation and shall give an alarm signal in case of temperature going beyond a set limit.
- c) Shall be able to work with higher temperature with automatic de-rating (80% capacity at 50°C)
- d) Storage temperature shall be from 0°C to 70°C with suitable packing
- e) Active filters shall be suitable for operation in relative humidity up to 95% non-condensing.
- f) Panel shall have an audible noise level lesser than 65db
- g) Panel shall have a filtering efficiency of at least 96%
- h) Panel shall have a reaction time of at least 80 micro-seconds
- i) Power factor correction shall always be set at priority
- j) Selection between the remainder features - harmonics compensation and load balancing - shall be programmable at the time of commissioning. In the default mode, harmonics compensation and load balancing.
- k) Auto fold-back of the HPFC panel if total current requirement exceeds the rated capacity of the panel
- l) All live parts of the system shall be properly shrouded
- m) Inspection terminal strip, number ferruling, and other labeling shall be suitably provided
- n) Stickers marked with "DANGER" shall be provided wherever required

- o) Detailed drawings and manuals shall be provided wherever required
- p) Following protections shall be provided:
 - i. Over voltage (AC) protection
 - ii. Over voltage (DC) protection
 - iii. Phase sequence protection
 - iv. Over current protection
 - v. Over temperature protection
 - vi. Protection circuits for the inverter stack and its components
- a. All components and wiring used in the system shall adhere to the relevant ISI and IEC standards

SWITCHGEAR & PROTECTION

Incomer switchgear shall be TP&N breaker appropriate rating. Suitable contactor for each step shall be used and must be capable of capacitor switching duty at each step for short circuit protection.

Bus bars shall be suitably colour coded and must be mounted on appropriate insulator supports.

Power cables used shall have superior mechanical, electrical and thermal properties, and shall have the capability to continuously operate at very high temperatures up to 125 deg.C.

Internal wiring between main bus-bars, breaker, contactor and capacitors shall be made with 1100 V grade, PVC insulated, copper conductor cable of appropriate size, by using suitable copper crimping terminal ends etc.

Suitable bus links for input supply cable termination shall be provided.

CONTROL CIRCUIT & GENERAL PROTECTION

The control circuit shall be duly protected by using suitable rating MCB.

An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset).

Wiring of the control circuit shall be done by using 1.5 sq.mm, 1100 V grade, PVC insulated, multi-stranded copper control wire.

Inspection terminal strip, number ferruling, labeling etc. shall be provided.

440 V caution board on the panel shall be provided.

CAPACITORS

The capacitor shall comply with the following standards (and their latest amendments) : IS 13340-1993, IS 13341-1992, IEC 60831-1+2

General specifications: 3 phase, delta connected, 50 Hz.

Voltage: Must be designed to withstand system over voltage, increased voltage due to series reactor and harmonics. Minimum voltage rating of capacitor shall be 480V.

Capacitor type: Super heavy duty with double side metalized capacitor resin impregnated fitted with pressure sensitive disconnecter in each individual capacitor cell.

Over voltage +10% (12h / 24h), + 15% (30m/ 24h), + 20% (5m), +30% (1m) as per Clause 6.1 of IS 13340-1993.

Over current : 2.5 x In

Peak Inrush current withstand : (350) x In

Total watt-losses including discharge resistors: $\leq 0.45 \text{ W / k V Ar}$.

Temperature category: -25 deg.C to 65 deg.C.

Capacitor shall be self-heating type and resin impregnated for longer life. The impregnate shall be non-PCB, biodegradable type, must be properly treated and de-gasified, so as not to have any degeneration properties and shall be non-oxidizing.

The design shall be modular for simple mechanical assembly, no extra accessories/ metal parts to be required. Unit must be free standing with an IP 42 protection level.

CAPACITOR CONSTRUCTION

Capacitor Unit

Each step in the Hybrid power factor correction panel shall comprise of single unit or group of units connected in parallel to form a bank. Each capacitor unit/ module shall be provided with Pressure Sensitive Disconnecter or inbuilt fuses for safe disconnection. Each capacitor unit shall comprise of number of single-phase elements connected Delta configuration. All capacitor unit shall be provided with discharge resistors, which shall discharge the capacitors to less than 50 V within 1 minutes.

Capacitor Elements

Each element shall be wound from continuous reels of high quality polypropylene film combined with dual side metalized paper in the dielectric structure to form a cylindrical winding. Elements shall be vacuum dried, impregnated under high vacuum with non PCB oil.

SERIES REACTOR

Application

LV Harmonic Filters Copper Wound 14% detuned reactor shall be used with harmonic filter duty power capacitors to mitigate harmonics, improve power factor and avoid electrical resonance in LV electrical networks. As, this project contains most of load is single phase, Capacitor voltage shall be minimum 525 V when used with 14% reactors.

Construction, Testing & Protection

The low voltage filter reactor shall be series type having a three phase, iron core construction suitable for indoor use (IP 00). The reactor shall be air cooled and the layout shall be in accordance with IEC 60076.

The complete unit shall be impregnated under vacuum and over-pressure in impregnation resin and shall be suitable for temperature Class H (T60/H) operation.

The reactor shall be tested using a separate source voltage test of 3.0kV (coil to core) for 1 minute as per IEC 60076/3.

The permitted tolerance of inductance shall be + 3% of rated inductance value.

Reactor tuning factor shall be 14% and the current rating of the reactor shall include the effects of harmonics and other possible over-currents.

The limit of linearity of inductance of the filter reactor shall be as follows $1.2 \cdot \sum I_n$ with $L = 0.95 L_N$

The reactor shall be fitted with a temperature sensitive micro-switch in the centre coil (normally open) for connection to trip circuits in case of high operating temperatures.

10. BUSBAR TRUNKING SYSTEM AND RISING MAINS

Aluminum (all contacts should be silver/tin plated)

Manufactured Units

General

The busbar trunking and Rising Mains system, both feeder and plug-in, shall be sandwich construction.

All busbar trunking products and fittings (straight length, elbow, tees, flanged ends, cable tap box and circuit breaker, etc.) shall be in accordance with IEC 61439 Part 6 (2012) or UL857 and from the same manufacturer as the busbar trunking system. The degree of protection of the busbar trunking system should be IP54 in accordance to IEC 60529.

Rated insulation voltage of the busbar trunking is 1000V. 3 – Phase, 4 or 5 Wire with 50% capacity continual integral/internal earth busbar. The neutral conductor should have the same cross-sectional area as the phase conductor. The earth busbar must be one continuous piece without bolting on housing

The ampere ratings, approximate footage, fitting, plug-in units etc. is given in the BOQ.

Certificate

Complete bus trunking system including accessories of full range and each rating, should pass full type tests specified in IEC 61439 Part 6 (2012).

The certificate shall be issued by an international independent testing authority (e.g. ASTA, KEMA, ERDA, UL).

Type test certificate/ report shall be produced for validation before ordering for Rated Short Circuit breaking capacity for 1sec.

Type Test certificates/ report confirming Mechanical Operation and Temp. Rise of Tap Off Box / Plug-in Box of similar design in accordance with IEC-61439 are must.

Busway manufacturer shall produce a Type Test Certificate/ report determining Rating of Busway at Ambient Temp. with no deration. Failure to submit such reports will disqualify the manufacturer.

A Type Test report confirming Degree of Protection in accordance with IEC 60529 is must.

Seismic Zone V type test for IEC-60068 of seismic with acceleration or IEEE:693-2005 and IS:1893 -2002 with plug in box energized. certificate from independent test house is a must.

Short Circuit Ratings and Tests

The whole busbar trunking system shall be capable of withstanding the short circuit of the electrical installation without damaging the electrical, mechanical and thermal stress under fault condition at a service voltage of 1000V 50Hz. The minimum rated insulation voltage shall be 1000V.

Basic Construction

Housing

The busbar trunking housing shall be constructed of electro galvanized steel of min 1.6 mm thickness to reduce hysteresis and eddy current loses and shall be provided with a suitable protective finish of ANSI 49 or RAL 7032 grey epoxy paint.

The busbar trunking housing shall be totally enclosed non-ventilated for protection against mechanical damage and dust accumulation. And it shall pass salt spray test to ensure the anticorrosion ability as per IEC 61439.

The totally enclosed housing shall be manufactured by the busbar trunking manufacturer.

Busbars

There shall be no bolts passing through the busbars of the busway. Each busbar shall be insulated F (155 °C) UL certified polyester material. Busbar size should be as per the type test report of the manufactures.

The temperature rise at any point of the busbar trunking enclosure shall not exceed 55-degree Centigrade rise above ambient temperature when operation at rated current.

Joint

The busbar trunking joint shall be of the one-bolt type which utilizes a high strength steel bolt(s) and Belleville washers to maintain proper pressure over a large contact surface area.

The bolt shall be torque indicating and at earth potential.

The bolt shall be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated. All joints shall have silver plated copper contacts.

Access shall be required to only one side of the busbar trunking for tightening joint bolts. It shall be possible to remove any joint connection assembly to allow electrical isolation or physical removal of a busbar trunking length without disturbing adjacent busbar trunking lengths.

Plug-in Box/ Tap-off box

The connecting jaw of the plug-in unit shall plug directly onto the busbar and have full contact with busbar itself. Welded tab at plug-in busbar is not allowed.

All contact on joint and plug-in opening should be silver or tin plated copper.

On plug-in busbar trunking there shall be three dead front, hinged cover type plug-in openings on each side.

All openings shall be usable simultaneously.

Busbar trunking shall be installed so that plugs are side mounted to permit practical use of all plug-in openings.

It shall be possible to inspect the plug-in opening and busbars prior to the installation of the plug-in units.

Plug in box (**Tap-off Box**) should comply to online operation (insert or remove under live condition). The enclosure shall be thickness of 1.6mm.

Plug in box MCCB/MCB and **End Feed Unit** having ACB/MCCB of same bus bar trunking system of OEM switchgear manufacturer. The End Feed Unit enclosure shall be thickness of 1.6mm.

Support of busbar Trunking

Hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations.

Indoor feeder and plug-in busbar trunking shall be approved for hanger spacing of up to 3 meters for horizontally mounted run and 4 meters for vertically mounted runs. Outdoor

feeder busbar trunking shall be approved for spacing of up to 1.5 meters for horizontally or vertically mounted runs.

Voltage drop

The voltage drop (input voltage minus output voltage) specified shall be based on the busway operating at full rated current and at stabilized operating temperature in 30 ambient.

The three-phase, line to line voltage drop shall not exceed 3.4 volts per hundred feet at 40% power factor concentrated load which may exist during motor starting.

The line-to-line voltage drop shall not exceed 4.1 volts per hundred feet at the load power factor which produces maximum voltage drop in the busway.

11. ISOLATED PANEL SYSTEM for OT

General principles

The electrical installation shall comply with or exceed the IEC 60364-7-710 international or local medical standards.

Electrical power availability and quality are crucial to the safety of patients in the running of an operating theatre. Operating theatre electrical installations must ensure continuity of care and provide protection against electric shocks under all circumstances; the solution implemented must therefore meet the following criteria:

- **Energy availability:** Design that fulfils the IEC 60364-7-710 requirements for the Criticality level 1. The requirement for "less than 0.5 second outages" is managed using a UPS and automatic change over. The 3 hours endurance is managed using an upstream generator backup system. The supplier shall produce dependability calculations for the solution in terms of MTBF (mean time between failures) in relation to undesirable events. The unavailability time of the IT outlets during an operation shall be < 0.04 min/year.
- **Electrical shock protection:** according the IEC 60364-7-710 standard the solution is in compliance with the group 2 location through isolation transformer and associated monitoring system.

Electrical switchgear for each operating theatre - description

The operating theatre electrical switchgear shall be installed in the operating room corridor or in the vicinity of each room.

According the IEC standard, the switchgear is energy by 2 separate sourcing.

The "Main incomer supply" is coming from the UPS system. The "Safety incomer supply" is coming directly from the other part of the main low voltage switchgear.

An automatic change over shall transfer the energy sourcing from the "Main incomer supply" to the "Safety incomer supply" in case of outages in less than 30ms.

The Utility and Genset sourcing should limit by 15 seconds at least any potential outage to reenergise the Main and Safety incomers.

Total breaker selectivity has to be managed by circuit breaker protection up-stream of the isolation panel with more than 63A current rating and curve D to limit tripping due to inrush current.

To ensure a high level of fault discrimination and to increase power availability, 12 circuit breakers at minimum shall be used to protect short, separate circuits, in particular for the isolated power outlets (wall outlets or surgical/anaesthesia pendants).

According the IEC standard each circuit breaker shall protect 3 outlets maximum..

All the operating room electrical cabinets shall be wired and physically organised in the same way.

The wiring shall be in compliance with the recommendations of IEC 60364-4-41, IEC 61000-6-2 and IEC 61000-6-3.

It shall be possible for the protective devices to be controlled by the maintenance staff, without risk of direct contact.

The power and communication circuit routing shall be completely separate.

- Propagation of electrical fields shall be prevented by physical separation systems (in accordance with IEC 61439-1).

Environmental conditions (operating room or electrical room):

- Situation: indoors,
- Altitude: ≤ 2000 m,
- Maximum ambient temperature: 30°C,
- Maximum relative humidity: 90%,
- Power dissipated by the switchboard: 465 W,
- The maximum sound level shall be less than 30 dB, measured 1.0 m from the ground.

Electrical data:

- Operating voltage: 230 V AC,
- Operating frequency: 50-60 Hz,
- Operating current: 63 A,
- Isc: 25 kA,
- Neutral systems: IT and TNS,
- 1 Transformer: 10 kVA.

Display and remote control in the Operating theatre:

The remote and monitoring system Vigilohm HRP or equivalent from approved make list, located in the operating room, is composed of:

- Insulation fault alarm (orange light)
- Electrical fault due to Isolation transformer overload or over heating, or tripping of a feeder circuit breaker (red light)
- A buzzer synchronised with the alarm status
- Normal operation (green light)
- Push button for insulation test
- Push button to mute the buzzer



Remote display: HRP

Communication feature

Communication facility

The IMD with communication facility allows the transfer to some monitoring system in Modbus RTU of the following alarms messages, including time stamping facility:

- Insulation fault
- Electrical fault (Isolated transformer Overload or Overheating, Feeder status)

Smartlink IP or equivalent from approved make list shall be used as an Ethernet gateway to transmit the data over Modbus

TCP/IP

Insulation fault location

Thanks the possibility to complete the Insulation fault diagnostic through feeder location facility in front face of the switchgear.



Insulation Fault Location :
XD312-H

Locating fault when circuit breaker trips

Communication auxiliaries, for communicating ON/OFF/Trip status shall be provided with all MCBs, RCCBs, RCBOs used for protection. The status shall be available over Modbus TCP/IP network. Smartlink or equivalent from approved make list shall be used for communicating the status of protection devices as mentioned above having inbuilt web pages for monitoring and control. It shall also be possible to send the alarms over email directly from the device used for communicating the status.

Energy monitoring

Pulse energy meters with inbuilt CTs shall be provided with incomers to the panel for getting the energy consumption data for operation theatre

Routine maintenance procedure

A complete verification of the system shall be carried out once a year by qualified staff who have been trained on the system. It shall focus, in particular, on the reliability of the electrical system, the behaviour of the components, the acquisition, measurement and communication system, as well as on the co-ordination with the upstream installation (electrical, data).

It shall be easy to replace all the solution components, without affecting any other components.

Standards compliance

The installation shall comply with the following standards:

- **IEC 61439-1 and -2**
"Low-voltage switchgear and control gear assemblies - General Rules" and "Low-voltage switchgear and control gear assemblies – Power switchgear and control gear assemblies".
- **IEC 60364-7-710**
"Electrical installations of buildings - Requirements for special installations or locations - Medical locations".
- **IEC 61557-8**
"Electrical safety in low-voltage distribution systems up to 1000 V AC and 1500 V DC - Equipment for testing, measuring or monitoring of protective measures - Part 8: Insulation monitoring devices for IT systems".
- **IEC 61558-2-15**
"Safety of power transformers, power supply units and similar - Part 2-15: Particular requirements for isolating transformers for the supply of medical locations".
- **IEC 60364-4-44**
"Low-voltage electrical installations - Protection for safety - Protection against voltage disturbances and electromagnetic disturbances".
- **IEC 61000-6-2**
"Electromagnetic compatibility (EMC) – Generic standards – Immunity for industrial environments".
- **IEC 61000-6-3**
"Electromagnetic compatibility (EMC) – Generic standards – Emission standard for residential, commercial and light-industrial environments".

TECHNICAL SPEC. & VALIDATION REQUIRMENTS

General Characteristics

Single phase, iron core, dry type IT Transformer Cooling:	AN
Protection degree:	IP00
Standard:	GB 19212.16-2005 / IEC 61558-2-15:2011
Insulation:	Reinforced insulation
Mounting:	Vertical mounting
Visual Aspect:	Sheet metal parts should avoid obvious scratch Structure: Compliant with GB 19212.16-2005

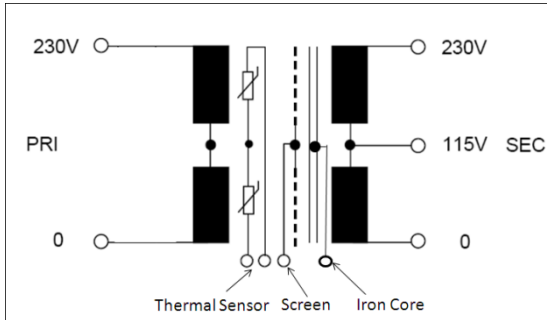
Technical specification

There are 3 references. Below table shows the main features of each reference:

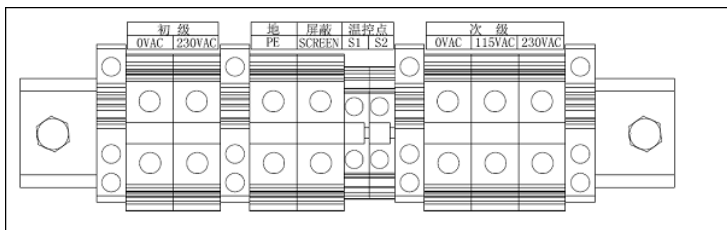
	Ref. #1	Ref. #2	Ref. #3
Capacity	6.3KVA	8KVA	10KVA
Primary Voltage	230V		
Secondary Voltage	230/115V		
Rated output	27.4A	34.8A	43.5A
Frequency	50/60Hz		
No Load output	Compatible with GB19212.16 Chapter 12		
No Load Current in	0.82A	1.0A	1.25A
No Load Loss in Un	100W	150W	200W
Short Circuit	< 3%* Un		
Inrush Current	< 12 * Imp (Rated input current peak)		
Leakage Current	Compatible with GB19212.16 Chapter 18		
Leakage Current(*)	<0.5mA.based on		and IEC 61558-2-
		15:2011	
Thermal Class	H		
Efficiency	>96%		
Dielectric between Primary and	4000Vac (Rms), 1min		
Dielectric between windings- metallic	4000Vac (Rms) , 1min		
Insulation Resistance	>100M Ohm between Primary & Secondary, Primary & Core, Secondary & Core Also compliant with GB19212.16 chapter 18		
Max Width(mm)	280	280	280
Max Depth(mm)	210	225	255
Max Height (mm)	427	427	427
Fix Holes(mm x	165X240 M10	180X240 M10	210X240 M10
Thermal Sensor	1. THERMIK S01-120 deg bi-metal sensor, normally closed 2. KRIWAN 120 deg PTC sensor which acc. To DIN 44081, only used in samples 3. The sensor is to measure the winding temperature		

Connector position and material:

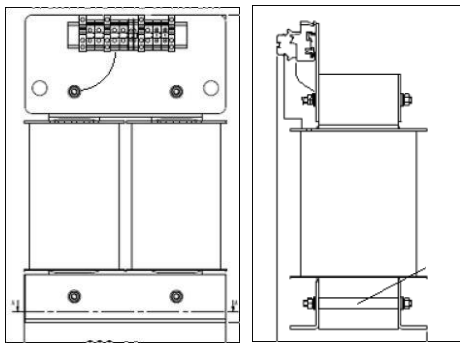
Electrical Diagram:



Terminal



Position:



Connector Supplier: Phoenix Connector

Connection details

Type	Input Terminal Flexible/Rigid	Screen winding Flexible/Rigid	Control terminals Flexible/Rigid	Output terminals Flexible/Rigid
6.3KVA	16/25 mm ²	16/25 mm ²	4/6 mm ²	16/25 mm ²
8.0KVA	16/25 mm ²	16/25 mm ²	4/6 mm ²	16/25 mm ²
10KVA	35/35 mm ²	35/35 mm ²	4/6 mm ²	35/35 mm ²

Environment

Use category	Indoor
Operation temperature	Altitude<2000m ,0□ to 40□
Storage temperature	Altitude<2000m , -25□ to 60□
Humidity for operating	20% to 80%
Salt fog endurance	GB19212.16

Sound level	< 50 dB
Anti corrosion protection	GB19212.16
Resistance to Vibration	Vibration according to IEC 60068-2-6 : 1.5mm from 3 to 13Hz, 1gn from 13
Shock	Shocks according to IEC 60068-2-27 : 15gn shock- resistance for 11ms on
Life Time	≥ 20 years

Marking/Package

Label

For each reference, please refer to the label design specification.

Label Position

Product label should be put in top face of the Iron core.

For each reference, each label, the position should be consistent.

Package Design

Please refer to the package design document.

Qualification

The manufacturer is required to provide type test reports according to GB 19212.16 standard and to the present specification. All qualification test are defined in the table below:

The manufacture should perform the following routine test for each product. Surveillance test are not needed for each product, but test frequency will be defined.

Routine test and Surveillance test

S.no.	Designation	Test description	Sampling	Validation Criteria
1.	Hi-pot	According to GB 19212.16	Routine test	See following table for the test details
2.	Insulation Resistance test	According to GB 19212.16	Routine test	Compliance with GB19212.16 Para 18
3.	Appearance test	According to GB 19212.16	Routine test	1.No rust, distortion& scrap on the surface of the transformer 2. Overall dimensions, mechanical dimension & other construction design must meet standard
4.	No-load output voltage	According to GB 19212.16	Routine test	Compliance with GB19212.16 Para 12
5.	Short Circuit Voltage	According to GB 19212.16	Routine test	Should less than $U_n * 3\%$ Compliance with GB19212.16 Para 13

S.no.	Designation	Test description	Sampling	Validation Criteria
6.	No-load input current	According to GB 19212.16	Routine test	Should less than Un*3%Compliance with GB19212.16 Para 13
7.	Ground Resistance continuity test	According to GB19212.16.To measure two farthest two points in sheet metal parts	(Surveillance Test)	< 0.1 Ohm
8.	Inrush current	According to GB 19212.16	Routine test	Should less than Un*3%Compliance with GB19212.16 Para 13
Routine Tests				
Hi-Pot tests		Tested voltage	time	
Primary winding-secondary winding		* 4800Vac(rms)	2 secs	
Primary winding-core(ground)		* 4800Vac(rms)	2 secs	
Primary winding-Screen		* 4800Vac(rms)	2 secs	
Primary winding-Thermal sensor		* 4800Vac(rms)	2 secs	
Secondary winding-core(ground)		* 4800Vac(rms)	2 secs	
Secondary winding-Screen		* 4800Vac(rms)	2 secs	
Secondary winding-Thermal sensor		* 4800Vac(rms)	2 secs	

Type test

1. Type tests are tests conducted on a unit which is representative of a production series or type of product IT transformer should comply with GB19212.16.

Environmental test

1. **Humidity test** : **GB/T 2423.3-2006**
2. **Heat test** : **GB/T 2423.2-2001**
3. **Cold test** : **GB/T 2423.1-2001**
4. **Salt & fog spray test** : **GB/T 2423.17-1993**
5. **Noise test** : **According to GB 22337-2008, < 50dB**

ROHS +CHINA ROHS MARK, REACH

RoHS conformity : 2011/65/EU China RoHS Mark: SJ/T11364-2006

REACH assessment: European regulation (EC) No 1907/2006(TBD)

MANUALS

1. Instruction Sheet : Specific leaflet for each package box .

TRANSPORTATION REQUIREMENT

Normally the transformer can't be stacked during transportation unless the manufacture prove that package design is strong enough for stacking and will not cause any damage to the IT transformer.

Anyway, two layers are the maximum during transportation.

12. DG SET (AIR COOLED)

1.0 The tenderer shall submit detailed schematic diagram for the approval of the Engineer-in-charge. He will make sure that the equipment offered shall fulfil the design conditions. All the equipments and their installation shall be suitable for the environmental conditions encountered at the location as indicated in specifications. If any deviations from the Tender specification are contemplated, these shall be clearly brought out in the- tender along with the reasons for the same. If the tenderer fails to bring out specific deviations, it will be presumed that the work shall be carried out as per tender specifications. The tenderer shall submit the de-rating calculations for engine as well as alternator along with supporting manufacture catalogues & model no of Engine & Alternator, offered.

2.0 Conformity to Statutory Acts, Rules, Regulations, Standards and safety Codes.

CPWD Specifications:

The entire work shall be carried out as per following CPWD General Specifications for Electrical works wherever applicable and as amended up-to-date. CPWD General Specification for Electrical works (Part-VII) DG Set 2013.

CPWD General Specification for Electrical works (Part-I) Internal – 2023

CPWD General Specification for Electrical works, (Part-II) External -2023

CPWD General Specification for Electrical works, (Part-IV) Sub-Station- 2013

The tender specifications wherever they differ from these specifications as indicated above, shall have overriding value and shall be followed for this work.

Indian Electricity Act and Rules:

All electrical works in connection with installation shall be carried out in accordance with the provision of Indian Electricity Act 2003 and Indian Electricity Rules 1956, both amended up-to date.

Indian Standards:

All the components shall conform to relevant Indian Standard specifications, wherever existing, amended to date. A list of such standards is appended in appendix I.

Fire Regulation:

The installation shall be carried out in conformity with the local Fire Regulations and Rules there under wherever they are in force and the provisions in local bye-laws, if any.

Safety Code and Labour Regulation:

In respect of all labour employed directly or indirectly on the work for the performance of contractor's part of work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provisions, B.I.S. recommendations, factory act, workman's compensation act, CPWD Code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty for Rs. 200/-for each violation. In addition the Engineer-in-Charge, shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost from the contractor.

The contractor shall provide necessary barriers, warning signals and other safety measures while executing the work of DG set installation, cables etc. or wherever necessary so as to avoid accident. He shall also indemnify CPWD against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damaged incurred or claims arising there from during the execution of work. The contractor shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

Central Pollution Control Board (CPCB) NORMS:

The DG Sets shall comply with the latest CPCB norms regarding emission and noise norms amended upto date.

The firm need to furnish the certificate of Type approval and certificate of conformity of production issued by the Central Pollution Control Board (CPCB) or any authorised agency as prescribed in the above law.

3.0 Scope of work (As per Site conditions altitude 1000, Temp. 2 deg. to 40 deg.)

The detailed scope of supply, installation, testing and commissioning includes the following:

(4x1500 KVA) Diesel Generating Sets capacity at 0.8 power factor developing 415 volts 3 phase 4 wire output with the engine and alternator mounted on common bed plate complete and all accessories required. The DG Sets shall be capable of delivering desired KVA at 0.8 P.F for the external load after meeting its own requirement for auxiliaries etc. and after accounting for de-rating due to various factors, site conditions.

Necessary acoustic enclosure.

Necessary piping required for Fuel, Lubricating oil system, and exhaust piping.

Necessary Heavy duty batteries for starting including cable work.

Necessary control Panel as per detailed specification.

Necessary set of foundation bolts and suitable vibration isolation mountings.

Minor building work including cutting and making good of openings in wall and floors, grouting etc. as required.

All clamps support etc. for all components of the installation as required.

Necessary earthing, comprising of system neutral earthing and loop earthing etc.

4.0 Schedule of guaranteed technical particulars:

While tendering the tenderer should submit the details of technical particulars as per annexure- (II) of all items of material to be supplied for this work in case of acceptance of his offer.

5.0 Acceptable make:

Approved makes of materials to be used in the work have been appended in Appendix - (IV).

6.0 Diesel Engine

6.1 Engine rating

The engines shall be direct injection multi cylinder, vertical, 4 stroke cycles, Air cooled, turbo charged diesel engine developing suitable BHP for giving a prime power output of (4x1500 KVA) Diesel Generating Sets at 0.8 P.F. at the load terminals of the respective alternators (exclusive of the power requirements of auxiliaries deriving power from the engine) (as per ISO 8528 part-I).

The engines shall be capable for delivering specified prime power rating at variable loads for PF of 0.8 lag with 10% overload available in excess of specified output for one hour in every 12 hours. The average load factor of the engine over period of 24 hours shall be 0.85 (85%) for prime power output. The engines shall conform to BS 5514/ BS 649/ IS10000/ ISO: 3046 amended upto date. The engines shall be fitted with following accessories.

- Fly. Wheel housing & flywheel to suit single/ double bearing alternator.
- Holset flexible coupling and guard for double bearing alternator.

Dry type replaceable paper element air cleaner with restriction indicator (fuel, lube oil and by-pass).

Corrosion Inhibitor Coolant.

An electronic speed governor (A1 class) to maintain engine speed at all conditions of load.
M.S. sheet daily fuel service tank of 990 litres capacity with mounting brackets, complete with level indicator, fuel inlet and outlet, air vent, drain plug, inlet arrangement for direct filling and set of 5 ft long fuel hoses.

Residential exhaust silencers with flanges.

- Self starter 24 V DC

Battery Charging alternator unit and voltage regulator, 4 No. 12 Volts 27 plates 180 Ampere hour heavy duty lead acid type batteries, insulated battery racks with interconnecting leads and terminals. The connection between battery charger and batteries shall be provided with suitable copper leads with lugs etc.

Necessary pumps for lubricating oil, priming of engine bearing as well as fuel system etc. as required.

Exhaust gas turbo charger with after cooler.

- Lubricating oil cooler.
(Electronic/ Digital Genset Controller)
- Fuel injector.
- Fuel control solenoid.
- Fuel pump with engine speed adjustment.
- Safety controls against low lube oil pressure, high cooling water temperature and fail to start.
- Base frame as per manufacturer's specification including required nos. of anti vibration cushy foot mountings.
- Necessary over-speed trip on the engine.
- Exhaust piping wrapped with mineral wool / rock wool complete with aluminium cladding.
- Heavy Duty Radiator, radiator fan and mounting.
- Set of standard tools. All moving parts of the engine shall be mechanically guarded in such manner that a human cannot touch any moving part.

6.1.1 The manufacturers shall furnish certificate that the engine for the DG set that it complies with the latest CPCB Emission norms.

6.2 **Governor**

The Governor shall be Electronic type conforming to Class A1 G3 essential for Hospital like critical facility shall be self-contained unit capable of monitoring speed. It shall be suitable for remote operation. This should conform to ISO 3046/ BS 5514 with actuator as per standard design of manufacturer.

6.3 **Frequency variation**

The engine speed shall be so maintained that frequency variation at constant load including no load shall remain within a band of 1% of rated frequency.

Fuel System

It shall be fed through engine driven fuel pump. A replaceable element of fuel filter shall be suitably located to permit easy servicing. The daily service tank shall be complete with necessary supports, gauges, connecting pipe work etc. Pipe sealant should be used for sealing all connections. No Teflon tape is to be used.

6.5 **Lubricating oil system**

It shall be so designed that when the engine starts after a long shut down lubricating failure does not occur.

6.6 **Starting System :-**

This shall comprise of necessary set of heavy duty batteries (four nos 12 V D.C.), and suitable starter motors, axial gear to match with the toothed ring on the fly wheel. Battery capacity shall be suitable for meeting the needs of the starting system as well as the requirements of control panel, indications and auxiliaries such as priming pump etc. the scope shall cover all cabling, terminals including initial charging etc. The system shall be capable of starting the DG Set within 20-30 sec, even in winter condition with an ambient temperature down to 00 C.

6.7 PIPE WORK

General :

All piping work shall conform to quality standards and shall be carried out as per specifications and details given hereunder:

Pipes:

All pipes in sizes 200 shall M.S. E.R.W. tube (black steel) heavy class as per I.S. 1239-79, Part -1 with amendment-I. All pipes above 150 mm dia. shall be minimum 6.4 mm thick.

Fittings:

The dimensions of the fittings shall conform to I.S. 1239/69 Part-II unless otherwise indicated, in the specifications.

All bends in sizes up to and including 150 mm dia., shall be ready, made of heavy duty, wrought steel of appropriate class.

All bends in sizes 200 mm and larger dia., shall be fabricated from pipes of the same dia and thickness, with a minimum of 4 sections, and having a minimum centre line radius of 1.5 diameter of pipes. All fittings such as branches reducers etc. in all sizes shall be fabricated from pipes of the same dia. And thickness and its length should be at least twice the dia. of the pipe.

The branches may be welded straight to the main line without making a separate fitting, where specified on drawings or required by engineer-in-charge.

Blank ends are to be formed with flanged joints and 6 mm thick blank between flange pair for 150 mm and over, in case where, a future extension is to be made otherwise blank and discs of 6 mm thickness are to be welded on, with additional cross stiffeners from 50mm x 50mm M.S. Heavy angles, for sizes up to 350mm. All ends larger than 400 mm dia. shall have dished ends.

Flanges.

All flanges shall be of mild steel as per I.S. 6392/71 and shall be steel slip-on-type, welded to the pipes, flanges thickness shall be to suit class-II pressures.

Flanges may be tack welded into position, but all final welding shall be done with joints dismantled. 3 mm thick gaskets shall be used with all flanges joints. The gaskets shall be filler reinforced rubber as approved by the Engineer-in-charge. Special adhesive compound shall be used between flanges of steam, air and gas lines.

Flanges shall be used as follows :-

Counter flanges for equipment having flanges connections.

Flanged pairs shall be used on all such equipment, which may require to be isolated or removed for service e.g. Pumps, refrigeration machines air handling units etc.

All thread valves shall be provided with nipples and flanged pairs on both sides to permit flange connections, for removal of valves from main line for repair/replacement.

Valve :

Butterfly Valves

The butterfly valve shall consist of cast iron body preferably in two piece construction.

The discs shall consist of disc pivot and driving stem shall be in one piece centrally located.

The valve seat shall be synthetic material suitable for water duty. It shall line the whole body.

The discs should move in slides bearing on both ends with 'o' ring to prevent leakage.

The handle should have arrangement for locking in any set position.

All gate valves and check valves up to & including 65 mm dia. shall be of gunmetal screwed type, conforming to class 2 of I.S. 778. and shall be with I.S.I marking and certification.

All gate valves and check valves up to 80 mm dia . and above shall be of cast iron flanged type, conforming to class 2 of I.S. 780/69 (for sizes up to 350 mm) and of I.S. 2906/69 (for sizes 350 mm and above) marking and certification.

All gauge cocks shall be of gunmetal plug type, complete with siphon (brass chrome plated).

All drain valves shall be of gunmetal with a hose union connection of one hand.

All valves on the supply of fan coil units shall be of gunmetal ball type with integral water strainers, having (BSP) fpt inlet and flare type MPT outlet connection.

All valves on the return line of fan coil units shall be as in 5.6 but without integral water strainer.

Balancing Valves :

The balancing valves up to 80 mm dia. shall be of gunmetal screwed type conforming to B.S. 5154 or equivalent from approved make list specifications.

The valves shall be cast gunmetal ASTM B-62 and complete with non rising spindle. PTFE disc seal cast metal hand wheel. The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.

The valves shall be complete with two ports for connection to a mercury manometer, to measure the pressure drop, as well as a drain port.

The spindle shall have shielded screw to set the flow at the desired level.

The valves shall be used wherever specified.

Strainers :

The strainers shall either be pot type or 'Y' type with cast iron or fabricated steel body, tested up to pressure applicable for the valves as shown on the drawings.

The strainers shall have a perforated bronze sheet screen with 3 mm perforation and with a permanent magnet, to catch iron fillings.

Pot strainers shall be provided with flanged connection and 'Y' strainers shall be provided with flanged ends.

The strainers shall be designed to facilitate easy removal of filter screen for cleaning without disconnection of pipe line.

Jointing

All pipes line shall be welded type.

Square cut plain ends will be welded for pipes up to and including 100 mm dia.

All pipes 125 mm dia or larger will be beveled by 35 deg before welding.

Miscellaneous :

Provide all pipe work as required to make the apparatus connection complete and ready for regular and safe operation. Unless otherwise noted, connect all apparatus and equipment in accordance with manufacture's standard details, as approved by Engineer-in-charge.

Unless otherwise specified, pitch the lines of piping as follows:- All condensation drainage, including air handling unit and fan coil unit shall be pitched in the direction of flow to ensure adequate drainage, with an adequate trap seal to prevent leakage of air due to static pressure developed by air conditioning units. Pitch, 20 mm per meter wherever possible, but not less than 10 mm per meter.

Drains from other equipments shall be pitched similarly without trap seal.

Provide valves and capped connections for all low points in piping system, where necessary or required for draining system. Provide isolating valves & drain valves in all risers to permit repairs without interfering with the rest of the system.

Support piping independently of all equipment so that the equipment is not stressed by the piping weight or expansion.

To facilitate the maintenance, repair and replacement.

Provide shut-off valves where indicated and for individual equipment, units at inlet

And outlet, to permit unit removal for repairs, without interfering with the remainder of

The system. Additional shut-off valves shall be provided as required to enable all systems to be fully sectionalized. By-pass and stop valves shall be provided for all automatic control valves as specified.

Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation. No valves shall be installed with handles pointing down, unless unavoidable.

Cut the pipes accurately according to measurements, established site &

Work into phase without springing or forging.

Pipe supports shall be adjustable for height and prime coated with rust preventive paint & finish coated with grey paint, both as approved by engineer-in-charge. The spacing of Pipe supports shall not be more than that specified below:-

Nominal pipe size mm	spacing (meters)		
15	1.25
20&25	2.00
32, 30, 50, &65	2.50
80,100,&125	2.50
150&Above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stresses on the pipes. Pipe hangers shall be fixed on walls and ceiling by means of metallic approved dash fasteners.

Insulated piping shall be in such a manner as not to put undue pressure on the insulation, such as providing teak wood block between pipe and support.

Where pipes are to be buried under ground, they should be coated with one coat of bituminous paints. The top of the pipes shall not be less than 75 cms. From the ground level. Where this is not practical permission of engineer-in-charge shall be obtained for burning pipes at lesser depth. The pipes shall be surrounded on all sides by sand cushion of not less than 15 cms. After the pipes have been laid and top sand cushion proved, the trench shall be refilled with the excavated soil, excess soil shall be removed from the site of work by the contractor.

Hangers & Supports :

Hangers & supports shall be provided and installed for the piping and tubing wherever indicated, required or otherwise specified. Wherever necessary, additional hangers and support shall be provided to prevent vibration or excessive deflection of piping and tubing.

All Hangers & supports shall be made of steel or other durable and non-combustible material, given two coat of primer red oxide and then painted with aluminium colour paint. Wood wire or perforated strap iron shall not be used as permanent hangers or supports.

Hangers shall be supported from structural steel, concrete inserts & pipe racks, as specifically approved.

No hangers shall be secured to underside of light weight roof decking and light weight floor glass.

Mechanical equipment shall be suspended midway between steel joists and panel points. Drilling or punching of holes in steel joist members will not be permitted.

Sleeves:

Where pipes pass through floors, walls, etc provide Galvanized steel pipe sleeves 50 mm larger than outside diameter of pipe. Where pipes are insulated, sleeves shall be large enough to ample clearance for insulation.

Where pipes pass through outside walls or foundation, the space between pipe and sleeve shall be caulked with lead wool and oakum.

The centre of pipes shall be in the centre of sleeves, and sleeves shall be flush with the finished surface.

Expansion or Contraction:

The contractor shall provide for expansion and contraction of all piping installed by the use of swing connection and expansion loops.

Arrangement and alignment of Piping:

All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the engineer-in-charge. The piping shall be installed in a uniform manner, parallel to or perpendicular to walls or ceiling, and all changes in directions shall be made with fittings. The horizontal piping shall be run at right angle and shall not run diagonally across rooms or other piping. Wherever possible all piping shall be arranged to provide maximum head room. All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route, this contractor shall reroute his pipes as required to avoid interference, at the discretion of the engineer-in-charge

All piping shall be carefully installed to provide for proper alignment, slope and expansion. The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle.

Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.

Small tubing gauges, controls or other equipment installed on any apparatus, shall not be coiled nor excessive in length, but shall be neatly, carefully bent at all change in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.

The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

Testing:

In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall the piping, appliance be subjects to pressures exceeding their test ratings.

The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are first closed, by blank offs or flanges.

After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter. All strainers, valves and fitting shall be cleaned of all dirt, filling and debris.

All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 kg/sq. cm for a period of not less than 12 hours. All leaks and defects in the joints revealed during the testing shall be rectified to the satisfaction of the engineer-in-charge, without any extra cost.

All the piping system shall be tested in the presence of the engineer-in-charge or their authorized representative. Advance notice of test dates shall be given all equipments, labour, materials required for inspection, and repairs during the test shall be provided by the contractor. A test shall be repeated till the entire systems are found to be satisfactory to the above authority. The tests shall be carried out for a part of work if required by engineer-in-charge in order to avoid hindrance in the work of the insulation contractor.

All steam and condensate pipes shall be tested and proven tight under hydrostatic pressure of 20 kg/sq.cm, unless otherwise stated, for a minimum period of 4 hours without drop in pressure.

Miscellaneous piping, tests with air at 10.5kg/sq.cm for a minimum of 24 hours without drop in pressure.

Painting:

All pipes supports, hangers, etc, shall be given two coats of red oxide primer.

All pipes, which are not to be insulated, shall then be given one coat of finish paint, of a type and colour, as per ISI code.

6.8 Common bed plate

Engine and alternator shall be coupled by means of flexible coupling and both units shall be mounted on a common bed plate together with all ancillaries to ensure perfect alignment of engine and alternator with all minimum vibrations. The bed plate shall be such that it will be feasible to remove the engine sump without disturbing the engine assembly. Fabricated bed plate will be acceptable. The bed plate shall be suitable for installation on suitable anti-vibration mounting system.

6.9 Exhaust System

6.9.1 EXHAUST SILENCER PIPING

The Exhaust piping system for the DG set shall be as per CPWD Specifications meeting the requirements of CPCB Norms. The exhaust silencer piping system shall be of heavy duty MS pipes conforming to class B. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendation of the manufacturer. MS screws flanges and bends shall be used as per site requirements. Exhaust pipe inside the building shall be lagged with heat resistive glass wool of 48 kg / meter cube and then clad with Al. foil all along the pipe.

Exhaust Stack Height- In order to dispose exhaust above building height, minimum exhaust stack height should be as follows:-

- (a) For DG Sets up to 1000 KVA - $H = h + 0.2\sqrt{KVA}$ where H = Height of Exhaust stack, h = Height of building
- (b) For DG set above 1000 KVA - 30 M or 3M above the building height, whichever is higher

The Exhaust Piping stack shall be supported by suitable MS steel structure with twin aviation light at the top of the exhaust piping.

6.9.2 Exhaust system should create minimum back pressure.

Number of bends should be kept minimum and smooth bends should be used to minimize back pressure.

Pipe sleeve of large dia should be used while passing the pipe through concrete wall & gap should be filled with felt lining.

Exhaust piping inside the Acoustic Enclosure should be lagged with asbestos rope along with aluminium sheet cladding to avoid heat in put to the enclosure.

Exhaust flexible shall have its free length when it is installed.

'Class B' MS pipes and long bend / elbows should be used.

The exhaust outlet should be in the direction of prevailing winds and should not allow exhaust gases to entire air inlet / windows etc.

When tail end is horizontal, 45 Degree downward cut should be given at the end of the pipe to avoid rain water entry into exhaust piping.

When tail end is vertical, there should be rain trap to avoid rain water entry. If rain cap is used, the distance between exhaust pipe and rain cap should be higher than diameter of

pipe. Horizontal run of exhaust piping should slope downwards away from engine to the condensate trap. Silencer should be installed with drain plug at bottom.

Optimum Silencer Location: Location of the silencer in exhaust system has very definite influence on both reduction of noise and back pressure imposed on the system.

Care should be taken to ensure that no carbon particle emitted due to exhaust leaking enters and deposits on alternator windings and on open connections.

Support to exhaust piping: Exhaust piping should be supported in such manner that load of exhaust piping is not exerted to turbo charger.

- 6.10 3 **Monitoring and metering facilities** Microprocessor based Network communication module should be provided for generator set monitoring, metering, protection and control . It should be able to offer advanced levels of functions for reliability and optimum genset performance. It should be able to address the functions of voltage regulator, governor control and protective relays. The control system should have easy servicing capabilities that allows system parameters to be interrogated, monitored and adjusted with PC. It should have the facilities for monitoring and annunciation of the following parameters :

PARAMETERS which are to be monitored:

- a) Voltage (3-phase) ;
- b) Current (3-phase) ;
- c) Percentage Current;
- d) Percent Load;
- e) Power Factor;
- f) Frequency ;
- g) Real Power;
- h) Energy;
- i) Ground Fault ;
- j) High/Low A.C Voltage ;
- k) Reverse KW;
- l) Reverse KVAR ;
- m) Overload ;
- n) Oil pressure ;
- o) Low/High battery voltage ;
- p) Run Time ;
- q) Pre-low oil pressure ;
- r) Pre-high engine temperature ;
- s) Overspeed ; Low coolant level ;
- t) Low fuel level &
- u) AC charger failure.

PARAMETERS for which annunciation is required :

- a) High battery voltage ;
- b) Low battery voltage ;
- c) Genset running ;
- d) Pre-low oil pressure ;
- e) High engine water temp;
- f) low engine temperature ;
- g) overspeed ;
- h) fail to start ;
- i) not in automatic;
- j) low fuel ;
- k) low coolant level

PARAMETERS for which alarm is required :

- a) High A.C voltage;
- b) Low AC Voltage ;
- c) Under frequency ;
- d) overcurrent ;
- e) shortcircuit;
- f) Loss of field ;
- g) Fail to close ;
- h) overload ;

- i) Emergency stop ;
- j) COMMUNICATION FAILURE

7.0 **Air System**

It is preferable to provide vacuum indicator with all engines to indicate choked filter. Maximum air intake restrictions with clean and choked filters should be within prescribed limit as per OEM/ manufacturer recommendation for particular model of the engine. Genset should be supplied with medium duty air cleaners.

9.0 **Alternator**

9.1 **Synchronous Alternator:** Self/SEPARATILY excited, screen protected, self regulated, brush less alternator, Horizontal foot mounted in single bearing construction suitable for the following:

Rated PF	:	0.8 (lag)
Rated voltage	:	415
Rated frequency	:	50 Hz
No. of phases	:	3
Enclosure	:	SPDP
Degree of protection	:	IP-23
Ventilation	:	Self ventilated air cooled
Ambient Temperature	:	43 deg C maximum
Insulation class	:	F
Temperature Rise	:	Within class F limits at rated load
Voltage Regulation	:	0.5%
Winding Pitch	:	2/3 Pitch
Stator Winding	:	Double layer lap
Wave form distortion	:	No load < 1.8%, non distorting
balanced linear	:	load<5%
Overload duration/ capacity	:	10% for one hour in every 12 hours of continuous use.
Total Harmonic Factor	:	Better than 2%.
Excitation	:	Separately excited.
Type of AVR	:	Electronic
Type of Bearing and Lubrication	:	Anti-friction bearing with Grease
Lubrication	:	arrangement
Standard	:	BS:5000/IS - 4722 & IEC : 34 as
amended Up	:	to date.

Alternator should be able to deliver output rating at -4 deg C. to 40 deg C. ambient at 1578 meter altitude at MSL & at 50% RH.

9.2 **Excitation:** The alternator shall be brushless type and shall be SELF/separately excited self regulated having static excitation facility. The rectifier shall be suitable operation at high ambient temperature at site.

- a) There should be a separate source of exciter field power from a small permanent magnet field a.c generator mounted on the same shaft as the main machine which would act as the separately excited system.

The permanent magnet will produce an output voltage which is only dependent on speed and is independent of the load conditions. This constant output voltage is required to be fed to the exciter field through the Digital AVR/ Genset Controller.

- b) By comparing the main output sensed voltage the AVR decides on the proportion of permanent magnet machine output to Rectify and feed to the exciter field.

The exciter rotor output should then increase, establishing a strong main field and therefore a marked increase in main output voltage.

The AVR should sense and compare voltages and adjust exciter field excitation until desired output voltage is developed.

Automatic Voltage regulators (AVR)/ Genset Controller:

- a) Fully encapsulated AVR capable of withstanding humid and corrosive atmospheric conditions.
- b) Soft start circuitry to be provided for smooth controlled buildup of generator output voltage.
- c) Remote voltage adjustment facility is to be provided, if Separate AVR is Given Under frequency protection to be provided.

Fault Tripping: In the event of any fault e.g over voltage/ high bearing temperature high winding temperature or an external fault, the AVR/ genset controller shall remove the excitation voltage to the alternator. An emergency trip shall also be provided.

Standards: the alternator shall be in accordance with the following standards as are applicable.

IS: 4722/BS: 2613/ 1970. the performance of rotating electrical machine.

IS: 4889/ BS: 269 rules for method of declaring efficiency of electrical machine.

Performance: Voltage dip shall not exceed 20% of the rated voltage for any step load or transient load as per ISO:8528 (Part-I). The winding shall not develop hot spots exceeding safe limits due to imbalance of 20% between any two phases from no load to full load.

The generator shall preferable by capable of withstanding a current equal 1.5 times the rated current for a period of not more than 15 second as required vide clause 14.1.1 of IS 4722: 1992

The performance characteristics of the alternator shall be as below:

- (a) Efficiency at full load 0.8 PF Not less than 93.5%
- (b) Total Harmonic distortion factor Less than 2%

- (c) (i) 10% overload One hour in every 12 hrs of continuous use.
- (ii) 50% overload 15 sec

Terminal Boxes: terminal boxes shall be suitable for terminating minimum aluminium UG cables. The terminal box shall be suitable to withstand the mechanical and terminal stresses developed due to any short circuit at the terminals.

Earth terminals: 2 nos. earth terminals on opposite site with vibration proof connections, non-ferrous hardware etc. with galvanized plate and passivated washer of minimum size 12mm dia hole shall be provided.

9.3 **Space Heaters:** ALTERNATORS should be provided with suitable space heaters to maintain the winding temperature automatically such that it does not absorb moisture during long idle periods. The heater terminals shall be brought to a separate terminal box suitable for 230 V AC supply and a permanent caution notice shall be displayed.

9.4 The alternator should be fitted with suitable nos. Resistance Temperature Device (RTD) & Bearing Temperature Device (BTD) along with space heaters. The terminal of space heaters will be wired to terminal box and the temperature scanner shall be provided in control panel for scaling the winding and bearing temperature.

10.0 **Battery/ Electrical System**

10.1 Batteries supplied with Genset are generally dry and uncharged. First charging of uncharged batteries is very important and should be done from authorized battery charging centre or factory pre charged Batteries should be given. Initial charging should be done for 72 – 80- hours. Batteries should be placed on insulated stands and relatively at cool place.

The battery should be (four Nos) 180 AH capacity 12 Volt, 27 plate and the size of copper conductor battery cable should be of 50 sq.mm or suitable size as per engine manufacturer.

11.0 Cabling

Bus ducting between alternator to Main panel should be done.

Multi core armoured copper cable should be used for inter connecting the engine controls with the switch gear and other equipments.

It is recommended to support output cables on separate structure on ground so that weights of cables should not fall on alternator/ base rail.

12.0 Foundation

The Genset is to be installed on the existing foundation. Genset should be mounted on AVM's inside the enclosure.

13.0 Acoustic enclosure:

13.1 The enclosure shall be made of such suppliers, who are approved/ certified by CPCB.

The canopy will enclose the following items inside: -

Diesel Engine.

Alternator.

Control Panel.

Four nos 12 Volt Starting Battery.

Daily service fuel tank (inside) or outside as per genset Manufacturer design feature.

Other accessories so that the DG set with all items and accessories could be placed in open space without any other requirement of Diesel Generator room suitable to withstand all weather conditions.

The acoustic enclosure shall be designed and manufactured conforming to relevant standards suitable for outdoor installation exposed to weather conditions, and to limit overall noise level to 75 dB (A) at a distance of 1 mtr. from the enclosure as per CPCB norms under free field conditions.

The construction should be such that it prevents entry of rain water splashing into the enclosure and allows free & quick flow of rain water to the ground in the event of heavy rain. The detailed construction shall conform to the details as under:

The acoustic enclosure will be made on the basis of modular construction i.e made in parts and can be assembled or disassembled at site. All members will be properly gasketed and bolted together. The structure should be weather proof.

The enclosure will be totally enclosed type made of high quality CRCA sheet of thickness at least 1.6 mm on the outside cover with inside cover having not less than 0.6 mm thick perforated powder coated CRCA sheet.

The sheet metal components shall be hot dip seven tanks pre-treated before powder coating.

The enclosure shall be powder coated (inside as well outside) with a special pure polyester based powder. All nut and bolts / external / hardware shall be made of Stainless Steel.

Sound proofing of the enclosure shall be done with high quality Fire Retardant insulation material i.e. Glass wool / mineral wool of minimum 100mm thickness and density of 64 KG /cubic meter to 100 Kg/cubic meter for sound absorption conforming to relevant IS to reduce the sound levels as per the CPCB norms. The sound proofing materials would be further covered with fine glass fibre cloth and would be supported by perforated MS sheet duly powder coated.

The doors shall be gasketed with high quality gaskets to prevent leakage of sound and the door handles shall be lockable type.

The enclosure shall be provided with suitable no of hinged type doors along the length of the enclosure for inspection, operation and maintenance purpose. Sufficient space should be provided inside the enclosure on all sides of the DG Set for inspection, easy maintenance and repairs.

The enclosure should accommodate the daily service fuel tank of 990 litres capacity to make the system compact

There shall be a provision for filling fuel from outside the enclosure with locking arrangement. Fuel tank should have provision for cleaning. The Fuel gauge shall have electrically operated – fuel gauge shall have to provided inside the enclosure. The fuel gauge should be able to show the level of the fuel even when the DG Set is not running.

The provision of external drain plug shall be kept for draining lub oil and diesel. Especially design attenuators shall be provided to control sound at air entry exit point. Especially design residential silencer shall be provided within the enclosure to reduce exhaust noise.

Adequate ventilation shall be provided to meet total air requirement. If required suitable numbers of axial flow fan (with motor and auto-start arrangement) and suitable size axial flow exhaust fan of suitable dia meter to take the hot air from the enclosure complete with necessary motors and auto start arrangement shall be provided as per the manufacturers design. The forced ventilation arrangement should be provided with auto stop arrangement to stop after 5 minutes of the stopping of D.G. sets.

The temperature rise inside the enclosure should not be more than 50deg C for maximum ambient above 40 deg C and it should be below -4 C for ambient below 40 C. Temperature Control Relay which continuously indicates the inside temperature of the canopy with variable setting for tripping the generator.

There shall be a provision of emergency shutdown from outside the enclosure.

Acoustic enclosure will be provided with flexible exhaust pipe connection with adequate and suitable arrangement of mounting of the residential silencer mounted on the top and concealed in the body of the enclosure. The exhaust pipe inside the enclosure must be lagged (except below).

The DG set will be provided with special spring mounted vibration damper to eliminate the vibration when DG set is working on full load.

The front panel should include engine RPM meter electrically operated.

There should have a provision of DC Emergency light operated automatically with door opening.

The inside of the enclosure shall be illuminated by the fluorescent tube with the help of PVC insulated copper conductor wiring in recess conduit suitable for single phase AC supply.

To avoid re-circulation of hot air, durable sealing between radiator and canopy is must. The acoustic enclosure should be suitable for cable connection.

14.0 System Operations

14.1 Manual Mode

It should be feasible to start-up the generator set by the operator on pressing the start push button.

Three attempts starting facilities shall be operative for the startup function.

Alternator circuit breakers closing and trip operation shall also be through the operator only by pressing the appropriate button on the panel and closure shall be feasible only after alternator has built up full voltage. If load is already on mains, pressure on close button shall be ineffective.

Engine shut down, otherwise due to faults, shall be manual by pressing a stop button.

14.2 Engine shut down and alternator protection equipments

Following shut down and protection system shall be integrated in the control Panel.

Engine

Low lubricating oil pressure shut down. This shall be inoperative during up and acceleration period.

High coolant (Water) temperature shut down.

Engine over speed shut down.

Alternator protection

Overload Short circuit
 Earth fault
 Over voltage

14.3 **Deleted**

14.4 **Operating devices**

A set of operation devices shall be incorporated in the front of panel as under.

a) Master Engine Control Switch

This shall cut off in "OFF" position DC control supply to the entire panel, thus preventing start-up of engine due to any cause. However, battery charger, lamp test button for testing the healthiness of indication lamps, DC volt meter, ammeter etc. shall be operative. It shall be feasible to lock the switch in OFF position for maintenance and shut down purposes.

Necessary provision for remote monitoring of the system parameters and its integration with the BMS system.

A Set of push buttons as specified.

Necessary battery charger with boost / trickle selector, DC voltmeter and DC ammeter.

15.0 **Inspection and Testing**

The successful tenderer will arrange staff/ fuel/ POL for test run at his cost.

Testing shall necessarily be carried out at factory/ manufacturer premises in presence of representative of the department.

For testing following procedure will be followed:

All major items/ equipments i.e. engine and alternator in assembled condition, associated electrical control panels etc. shall be offered for inspection and testing at factory/ manufacturers works. The successful tenderer shall give a notice of minimum two weeks for carrying out such tests. The Engineer-in-charge/ or his authorised representative shall witness such inspection & testing at mutually agreed date. The cost of the Dept's representative's visit to the factory will be borne by the Department.

The department also reserves the right to inspect the fabrication job at factory and successful tenderer has to make arrangements for the same.

DG set will be tested on load of unity power factor for the rated KW rating. During testing, the DG set covered under scope of the work, shall be operated for a period of 12 hours on the rated KW at DG set's KW rating i/c 1 hour of 10% over load after continuous run of the 12 hours. During testing all controls/ operations safeties will be checked and proper record will be maintained. Any defect/ abnormality noticed during testing shall rectified. The testing will be declared successful only when no abnormality/ failure is noticed during the testing. The DG set will be cleared for despatched to site only when the testing is declared successful by authorised representative/ Engineer-in-charge.

16.0 **Battery and Electrical System**

16.1 Batteries supplied with Genset are generally dry and uncharged. First charging of uncharged batteries is very important and should be done from authorised battery charging centre. Initial charging should be done for 72-80 hours. Also Factory Pre Charged batteries may be supplied, if Engine Manufacturer recommends.

16.2 Batteries should be placed on stands and relatively in cool place.

17.0 **Earthing system**

17.1 Copper earth plate electrode for neutral earthing of each alternator as per CPWD General Specification Part-I Internal 2005 and 2 Nos. for body earthing common for the five nos and two nos. sets.

17.2 The naked portion of the earth lead for neutral earthing of the alternator inside the enclosure shall be provided with PVC sleeve covering at no extra cost by the contractor.

1.1.1 AUTOMATIC GENERATOR SEQUENCING

- a) Automatically start & stop gen sets based on plant load or bus on process demand.
- b) Configurable plant bus demand start / stop levels and timers.
- c) On line engine priority sequence configurability from any synch. Unit or PC to equalize run time of all DG Sets.

1.1.2 AMF CUM SYNCHRONISING PANEL

The technical specification and details of the microprocessor based PLC controller for the DG set synchronizing and load sharing shall be as follows:

The microprocessor based PLC panel shall be suitable for use with AVR and electronic speed governor to protect and monitor DG sets.

Double Frequency Meter and Double Voltmeter shall be provided in synchronizing panel. Synchrony check relay also shall be provided.

The PLC shall be provided with following features and audible alarm:

- Engine pre glow control ○ Fuel solenoid control ○ Engine starter control ○ KVA controlled cool-down timer ○ Speed monitoring ○ Over speed protection ○ Oil pressure monitoring, alarm and shutdown of the engine
- Water temperature monitoring, alarm and shutdown of the engine ○ Battery voltage monitoring
- Over speed monitoring and alarm.
- 3 attempt start failure alarm ○ Under/Over Frequency ○ Reserve Power (Inverse time delay) ○ Loss of excitation ○ Over current (inverse time delay) ○ Loss of utility power detection ○ Load surge ○ Current unbalance ○ Voltage unbalance
- Mains Protection (vector shift, df/dt ROCOI) ○ True RMS power calculations accurate control ○ Configurable loading/unloading ramp rates ○ Isochronous load sharing of up to 4 units using percentage based load sharing ○ Base load control for optimum fuel efficiency ○ Import export control using a watt transducer ○ Soft utility tran

The PLC system shall be provided with built in relays for protection of the following:

- Reverse Power ○ Reverse KVAR ○ Over current ○ Under and over voltage ○ Under and over frequency ○ Synchronization check and earth fault relay.

The PLC system shall be suitable for load sharing by sensing active and reactive power.

The PLC system shall comprises of the following:

- Main processor unit ○ Power module for power supply to the processor and the system ○ Power monitor to monitor voltage, KVA, KVAR, KW, KWH, KVAH, KVARH.
- 16/32 channel Digital input module ○ 16/32 channel Digital output module ○ EEPROM for main processor unit ○ Computer to PLC communication card with necessary cables.
- Window based operator interface Software Package ○ Mounting chassis for the equipment
 - sfer function ○ Digital signal processing to eliminate harmonic issues ○ Adjustable phase window, Voltage and dwell time ○ Safe dead bus closing logic internal to the control
 - Synchronization across generator and mains breakers ○ Multiple short re-closing with adjustable time delay ○ Manual voltage and speed adjusts for manual synchronizing ○ VAR sharing on isolated busses using percentage based reactive load sharing ○ Power factor or VAR control when base loaded ○ Externally adjusta
- ble VAR or PF set point levels.
 - The DG set shall start and stop automatically based on plant bus demand.

The microprocessor based main processor of the system shall be suitable for 128 digital I/P and 128 O/P and comprises of the following:

The main processor unit shall be suitable for operation on 24 Volts DC with integrated memory. The integrated Ram memory shall be 20 K Words for program, data and constants plus data memory and flash EPROM of 16 K works for backup application program, communication card and real time clock. 4 Nos. discrete combination module (Input/output Module) shall be provided and the same shall be suitable for operation on 24 volts DC system. Combination module shall be with 16/32 inputs and 16/32 output channels as per the actual requirement.

- 1 No. 2 slot extension rack ○ 1 No. Ram back up battery unit ○ 8/4 Nos. digital input module ○ 8/4 Nos. digital output module

The CPU display unit shall be suitable for 4 lines of 40 characters. The display shall be with back lit LCD. Clarity shall be not less than 5 x 7 pixels. The height of the characters shall be not less than 5 mm. The data entry shall be with the help of 24 function keys. In addition to this there shall be 10 service keys and 12 alphanumeric keys. The system shall be provided with RS 232 communication port.

1.1.3 OPERATION AND COMMUNICATION

The PLC shall monitor the bus bar load continuously. In event of mains failure the PLC shall give signal to select and start the generator, which is closer to the load sensed during the last 60 seconds. In case the load at the time of main failure is more than the highest rating DG set, the PLC shall give command to start 2 Nos. DG sets to suit the load, synchronize the sets and give command to close the breaker on the main LV panel.

If load starts reducing the PLC shall give command to turn off the DG sets through cool down timer. On restoration of main power supply, the PLC shall check the voltage and frequency and if they are stabilized and within the permissible tolerances, the PLC shall give command to shut down the DG sets through cool down timer.

The control and monitoring of the cooling tower and fan and feed pump shall be done through PLC control system. Necessary control wiring between cooling tower, pumps and PLC panel shall be carried out within the scope of work.

1.1.4 SYNCHRONIZING MODULE

The synchronizing module shall be a microprocessor based intelligent unit, which shall monitor the electrical parameters and shall be able to communicate with the PLC control unit in the process of synchronizing and load management. The system shall be suitable for dynamic synchronization. The synchronizing module shall be suitable for programming and set the preferred difference between DG set and bus bar.

The synchronization module shall monitor and fulfill the following conditions before the system synchronizes the DG set to mains.

Feed back signal from the DG breaker on main LV panel that the breaker is in open condition.

The frequency regulator in the system shall start when the generator voltage and the bus bar voltage is over 50% of normal voltage. The voltage regulator in the system shall start when the frequency is within 90% of the normal system frequency.

The system shall close the breaker on the power panel without carrying out synchronization when all the below mentioned conditions are fulfilled. Feedback signal from the DG breaker on main LV panel that the breaker is in closed condition.

The synchronizing module shall transmit all monitored electrical parameters to the PLC unit and the PLC unit shall start controlling the synchronization of the DG sets and its load management. The data logging, monitoring and controlling shall be through a PC based PLC/BMS station.

13. UPS SYSTEM

Part I: GENERAL

1.1 SUMMARY

The UPS system offered shall be designed to provide power solutions for OTs/ICUs, Hospital Equipments, servers, workstations, Medical equipment, CCTV, Fire alarm system. This specification describes the architecture and the different components required for providing a Suitable solution for the critical requirements.

1.2 SPECIFICATION FOR MODULAR HOT-SWAPPABLE UPS SYSTEM

GENERAL FEATURES

The UPS shall be Double conversion type and shall provide a regulated and uninterrupted three-phase AC power, within specified tolerances, to critical station loads during normal and emergency operations. Each UPS frame shall incorporate sub power modules ranging from 25 KW to 60 KW. For Module rating, please refer schedule of items.

Each UPS system shall be provided with an AC voltage input which will be converted to DC voltage. The battery (Lead Acid Battery) will be connected to the charger output which will be fed to the inverter to provide 415V, 3 Phase, 4 wire, 50 Hz AC output. Same source shall be used as stand by source of 415V, 3 Phase, 4 wire, 50 Hz AC supply. In case of failure of the UPS system, the load will be automatically transferred to the stand by source by static switch. It shall have facility to disable static by pass switch.

UPS shall have FR Type and compliant to UL FR-V0, ABS Container, VRLA Battery (12 V Each). Battery Back-up shall be as per BOQ

Wherever Parallel systems are asked, All UPS shall be synchronized to make output waveform similar for all UPS as per BOQ Ratings.

Each UPS system should be serviceable independently.

Any one sub power module (25 KW to 60 KW) in any UPS frame shall not impact the capacity of other sub power modules in operation in that UPS frame as well as the other UPS frames operating in parallel in Double Conversion Mode of operation without going to bypass.

The Power Module shall be Hot-Swappable, the user shall be able to replace the power module in Online Mode.

1.3 DESCRIPTION

1. The power solution shall consist of the following features:
2. Three phase input and output.
3. High efficiency UPS
4. Input, Output, Bypass Isolators and Maintenance Bypass Switch shall be inbuilt in the UPS.
5. Battery units in a separate rack. Common battery bank feature shall be available.
6. Each UPS shall have external Input Isolation Transformer. Rating shall be as per BOQ.
7. Each UPS shall have SNMP & Modbus Card Inbuilt (these cards shall be cybersecurity certified for UL/IEC global standards for additional safety)
8. Each UPS shall have Environment Monitoring probe for Temp. & Humidity monitoring in the UPS Room. The temp. & humidity data should come through SNMP Monitoring software.
9. Battery(as per BOQ), Battery Rack, Battery MCCB, battery terminal caps, Battery MCCB enclosure, battery to battery interlinks, battery to UPS DC cable.

1.3.1 SUBMITTALS

The following documents shall be submitted within 15 days from issue of letter of commencement of work.

Product catalogue / data sheets.

System single-line operation diagram for site planning.

Battery Rack GA Diagram

UPS GA Diagram

Third Party Type Test Report w.r.t IEC 62040-3 for the UPS Models Offered (same or higher rating)

Cybersecurity certificate for UL/IEC global standards for SNMP Card

Environment Monitoring Probe Datasheet

SNMP Card Datasheet

Battery Datasheet to conform that battery is FR Type

1.4 ENVIRONMENTAL REQUIREMENTS

Operating ambient temperature: 0°C to 40°C.

Relative humidity: 0 to 95%, non-condensing.

SYSTEM RATINGS AND OPERATIONAL CHARACTERISTICS

Broadly following ratings are required for the mentioned areas:

- Small Medical & Office Equipment : 1 x 300 KVA/KW (N+1) Modular UPS in 400KVA Chassis using 60 KW Hot-Swappable Module
- Operation Theatres: 1 x 150 KVA/KW (N+N) Modular UPS in 200KVA + 200KVA chassis using 25 KW Hot-Swappable Module
- R&D Block: 1x 100 KVA/KW (N+1) Modular UPS in 200KVA chassis using 25 KW Hot-Swappable Module
- Hospital Elevators: 2 x 120 KVA Monolithic UPS in (N+1) Redundancy. Each UPS shall have inbuilt Heavy Duty Regen kit to be compatible with Lift Application.

SYSTEM INPUT

Input voltage rating: 3ph 415 V

Wide Voltage Window 340 -470 V.

Input frequency: 50 Hz + /- 10%

Input power factor: The PFC rectifier shall be power factor corrected so as to maintain an input power factor of 0.99 @ loads > 40% to ensure generator compatibility and avoid reflected harmonics from disturbing loads sharing the utility power. The rectifier output shall be filtered with a ripple current not exceeding 1% rms over the allowable continuous input voltage range.

Power walk-in/ Soft-Start: shall be linear from 0 to 100% of the load over a 10 second or higher period.

SYSTEM OUTPUT

Output voltage rating: 3 ph 415 V.

Output voltage regulation for steady state and transient variations for unbalanced load +/- 1%.

Frequency tolerance: 50 Hz, ±1.0 percent (free running)

Output harmonic distortion:

<3% THD maximum for a 100% linear load.

<5% THD maximum for a 100% non-linear load.

Short circuit withstand: The UPS must withstand a bolted-fault short circuit on the output without damage to the UPS system.

Acoustical noise: noise measured at 1 mtr. from the operator surface shall not be more than 75dB.

Output Waveform- Sine wave.

Online Mode Efficiency:

For Modular UPS ratings ≤ 200 KVA, the online double conversion Efficiency shall be $> 95.5\%$ from 25% to 75% Loading.

For Modular UPS ratings > 200 KVA, the online double conversion Efficiency shall be $> 97\%$ from 25% to 75% Loading.

Module Management system: Modular UPS Shall have a software feature to turn off the extra power modules under low load conditions so that the power losses could be reduced. The Modules shall turn -off automatically when load increases. Vendor to submit documentation & demonstrate this feature of power saving thru suitable documentation. ECO Mode / Energy Saver Mode Efficiency shall be 99%

(E) MODES OF OPERATION

The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:

Normal: UPS inverters continuously powers the critical AC load. The rectifier/chargers derives power from the mains AC power supply source converting this to DC power to supply the inverters, while simultaneously float/boost charging the battery system. Power supplied by the UPS inverters is, to within specified tolerances, at rated voltage and frequency.

ECO mode: The UPS system is configured to use static bypass operation as the preferred mode under predefined. Transfers to battery operation upon utility failure. Efficiency up to 99%.

Battery: Upon failure of the mains AC power supply source, the critical AC load is powered by the inverter, which gets, without interruption, power from the battery system. There shall be no interruption in power to the critical load upon failure or restoration of the mains AC power supply source. Upon restoration of the mains AC power supply source, power to the rectifier initially is restricted by a gradual power walk-in. Following the short power walk-in period, the rectifier powers the inverter and simultaneously recharges the battery through the battery converter. This shall be an automatic function and shall cause no interruption to the critical load.

Off-Battery or Frequency Converter: When the battery system is taken out of service for maintenance or the UPS is used as a frequency converter, it is disconnected from the battery converter and inverter by means of (an) external disconnects breaker(s). The UPS shall continue to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.

Static bypass - 100 percent rated, continuous duty: The static bypass transfer switch shall be solid state, rated for 100 percent continuous duty without mechanical contactor device in parallel for higher reliability and consistent response time and shall operate under the following conditions:

Automatic uninterrupted forward transfer: The static bypass transfer switch shall automatically forward transfer power, without interruption, after the UPS inverter is turned on after an instantaneous overload induced reverse transfer has occurred and the load current returns the UPS's nominal rating or less.

Manual transfer: A manual static transfer shall be initiated from the UPS control panel by turning the UPS inverter off.

Parallel: For higher capacity or higher reliability, the UPS outputs (3ph/4w) can be directly paralleled together; parallel controllers in every UPS automatically share the load. The largest parallel capacity is up to four times the nominal load of each unit composing the system i.e. Maximum 4 units of same capacity could be connected in parallel for N+1 redundancy.

COMPONENTS

Rectifier

Each UPS shall include an active power factor corrected, Insulated Gated Bipolar Transistor (IGBT) rectifier.

Input harmonic current suppression: The PFC rectifier shall produce a sinusoidal input AC current on each phase with low harmonic content, limiting THD on the UPS input to below 3 percent @ 100% load.

Battery charger current limiting: The UPS shall be equipped with a system designed to limit the battery recharge current.

Wide input voltage window: 340 - 470V @ 400 V Nominal Input

DC bus voltage shall be as per manufacturer's standard.

The DC bus voltage shall be compensated against temperature variations (Battery Temperature Compensation) to always maintain optimal battery float charging voltage for temperature excursions above or below 25°C.

DC ripple voltage shall be less than $\pm 1\%$ of nominal with no battery connected.

Pulse Width Modulation (PWM) current control shall be used. Digital Signal Processors (DSP) shall be used for all monitoring and control tasks. Analog control is not acceptable.

BATTERIES

Standard battery technology shall be 12V, VRLA, Maintenance Free type.

Batteries shall be housed in a separate battery rack with top covered

Each Battery Rack Shall have Battery MCCB & Battery MCCB Enclosure

Battery shall be FR Type

Battery Back-up Shall be as per BOQ

INVERTER

The inverter shall consist of fast switching 3 level IGBT.

Inverter shall be PWM controlled using DSP logic. Analog control shall not be acceptable.

The inverter shall be fully rated.

Nominal output voltage shall be 415 V, 3-phase, 50Hz, 4-wire plus ground.

Crest Factor: 3:1

Remote Emergency Power off (EPO) shall be provided.

Transient Recovery: The output voltage returns to within $\pm 5\%$ of the steady state value within 50ms.

Fault Clearing

The inverter shall electronically be turned off to protect against excessive overload conditions which exceed the parameters defined.

- UPS systems shall sense an overload condition and automatically transfer to the bypass input source which shall be used to provide the necessary fault clearing current required.

Inverter DC Protection

- The inverter shall be protected by the following features that shall be independently adjustable for maximum system flexibility.
- DC Over-voltage Trip.

- DC Under-voltage Shutdown.
- DC Under-voltage Disconnect annunciated by an internal visual alarm and relay contact closure.

Output Protection

- The inverter shall be electronically turned off to protect against overloads and abnormal load conditions which exceed the units rating.
- UPS systems shall sense an overload condition and automatically transfer to the bypass input source which shall be used to provide the necessary current required.

Over-current Protection

- The inverter shall be protected from excessive overloads, including reverse currents, by fast acting fuses to prevent damage to power semiconductors.

All fuses shall be provided with a blown fuse indicator with alarm indication on the control panel.

MECHANICAL

The UPS system, LIB batteries shall be housed in separate racks having the following specifications:

Powder coated finish of approved color.

Cable entry: Top & Bottom Both Type of cable entry should be available

Dust Filters and Rodent Mesh shall be provided

Conformal Coating on PCBs shall be provided

Cooling: Forced by internal blower/ fans.

Power Modules shall be Hot-Swappable

Man-Machine Interface (MMI)

UPS Display and Control Panel: Each UPS module shall be equipped with a Touch LCD display. This shall automatically provide all information relating to the current status of the UPS as well as being capable of displaying metered values. The display shall be menu-driven, permitting the user to easily navigate through operator screens.

Metered Values: An MCU or DSP shall control the display functions of the monitoring system. All three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accurate ($\pm 1\%$) representation of non-sinusoidal waveforms typical of computers and other sensitive loads. The following parameters shall be displayed:

Measurements:

Input voltage (Ph-Ph and PH-N).

Input current per phase.

Bypass voltage.

Bypass input frequency.

UPS output voltage (Ph-Ph and Ph-N).

UPS output current per phase.

UPS output frequency.

UPS output percent load.

UPS output kVA.

UPS output power factor.

Battery voltage.

Battery current.

Battery tentative backup time

Status indications and events:

- Load on battery.
- Load on UPS.
- Load on bypass.
- Low battery warning.
- General alarm.
- Remaining back-up time during operation on battery power.
- Bypass source outside tolerances.
- Additional indications shall provide maintenance assistance.

Time-stamped historical events: This function shall time stamp and store important status changes and anomalies.

Power Flow Mimic: Each UPS module display shall be equipped with a mimic to indicate power flow to the critical load along with an indication of the availability of the rectifier/charger, battery, automatic bypass, inverter, load. The mimic shall provide a quick and easy indication of the load level (displayed on LCD), including for overload conditions (displayed on LCD). This power flow is also shown in the LCD menu.

Alarms and Status Information: Alarm and status conditions shall be reported at a single module UPS system or at a paralleled module UPS or both. The display and control panel shall report the alarms and status information. Each alarm shall be visually displayed in text form and an audible alarm will sound for each alarm displayed.

Inverter ON/OFF: Each UPS module shall be equipped with an inverter ON/OFF buttons which will transfer the load from all UPS modules to the bypass mains supply, if it is available. The inverter ON/OFF control shall be protected under menu confirm protect if the bypass mains is not available.

Server shutdown:

The UPS, in conjunction with a network interface card, shall be able to gracefully shutdown one or more operating systems during an on-battery situation (Ethernet TCP/IP networks).

The UPS shall also be able to use an RS232 port to communicate over a DB9 serial cable and gracefully shutdown one or more operating systems during an on-battery situation. The UPS manufacturer shall have available software to support graceful shutdown and remote monitoring for the following systems: Linux, Novell, Solaris, Windows 7, Windows 10.

Remote UPS monitoring: Remote UPS monitoring shall be possible in three ways:

Web monitoring: Remote UPS monitoring shall be possible via a web browser such as Internet explorer or Netscape Navigator.

RJ45 monitoring: Remote UPS monitoring shall be possible via either RJ45 or contact closure of the UPS.

Simple Network Management Protocol (SNMP)

SNMP Card shall be cybersecurity certified for UL / IEC Global standards, certificate to be attached.

SNMP Card shall be latest technology & Gigabit Speed

STANDARDS

Safety: EN50091-1-1 / IEC 62040-1-1

Emissions: EN/IEC 62040-2

Performance: EN/IEC 62040-3

ISO9001, ISO14001. ISO 450001

UPS Manufacturing plant shall have Air & Water Pollution Clearance Certificate from local Govt. Body.

Other technical requirements/specifications

Earthing of UPS

Requirement of earthing shall clearly be brought out by the vendor.

Installation

The UPS shall be installed by a fully trained personnel on the UPS by the successful tenderer who will have to conduct load/ site study prior to the commissioning of the UPS. A copy of the load/site study report will have to be submitted with required comments.

Visual Inspection

Inspect equipment for sign of damage.

Verify installation as per drawing

Inspect cabinet for foreign object

Verify neutral and ground conductors are properly sized and configured.

Inspect battery cases.

Inspect battery for proper polarity

Verify all printed boards are configured properly.

Mechanical Inspection

Check all control wiring connections for tightness

Check all power wiring connections for tightness

Check all terminals, screws, nuts and /or spade lugs for tightness

Electrical Inspection

Check all fuses for continuity

Conform input voltage and phase rotation is correct

UPS Shall be commissioned in line with OEM standards

Documentation

The manufacturer shall supply minimum 2 sets of an installation manual with Installation Start-up trouble shooting guide and operation instruction of the specified system.

Specifications for Monolithic UPS (Lift Use): -

S.NO.	PARAMETERS	SPECIFICATION	COMPLIANCE (Yes/No)
a)	True Online Double Conversion type - 120 KVA/108KW, 3 phase UPS		
b)	The UPS shall have dual feed capability (one for rectifier & other for bypass)		
c)	Monolithic Design with heavy Duty regen Kit for compatibility to Lifts. Parallel Capability for making system 2 x 120 KVA (N+1) as per schedule of items.		
d)	IGBT rectifier & IGBT Inverter to maintain Input THDi less than 5% & output THDv < 3% @ 100% linear load In Addition, UPS should have automatic power factor correction at rectifier to maintain 0.99 P.f w.r.t. input feeder.		
e)	Wrap Around System by-pass to isolate UPS from critical load while maintaining power to loads. In addition Input, output & Bypass Isolators shall also be inbuilt inside the UPS.		

S.NO.	PARAMETERS	SPECIFICATION	COMPLIANCE (Yes/No)
f)	Electrical Input	Main/ DG set compatible 400V AC +/-15%, 3 phase 4 wires, 50/60 Hz frequency along with input surge protection.	
g)	Electrical Output	400V AC 3 phase, +/- 1% for static and +/- 5% for dynamic 100% load change.	
h)	Output Power Quality	Harmonic distortion less than 3% THD for linear loads and less than 5% THD for non linear loads.	
i)	Output Power Factor	0.9 or more	
j)	Static Bypass Manual Bypass	Required Inbuilt.	
k)	Cable Entry	UPS shall have Bottom & Top Cable entry provisions.	
l)	Battery	12V, VRLA Battery as per back-up mentioned in BOQ. Battery Rack with top covered, Battery to Battery Interlinks, Battery Terminal Caps & Battery to UPS DC cable (total 20 meters) shall be provided.	
m)	Environment Monitoring	UPS shall be provided with temp. & humidity monitoring probe which can be connected with SNMP card to continuously monitor the Temp. & humidity in UPS Room	
n)	Cooling System	Cooling with redundant cooling fans. Front access for all service & maintenance. Dust Filters shall be available on front door for prevention from dust.	
o)	Operating Conditions	Operating temp: 0 degree to + 40 degree C, Relative humidity 5 to 95%	
p)	Cyber-security	The SNMP card provided with UPS shall be UL/ IEC Cybersecurity Certified.	
q)	Suitability for Lift application	required	
r)	LCD Display	required	
s)	Facility for automatic bypass Under the following conditions: (i) Load exceeds permissible limits. (ii) No battery backup. (iii) Inverter failure.		
t)	Miscellaneous: Self-test & diagnostic feature, SNMP /web based monitoring & management, advanced battery management features like periodic battery test & protection against battery low cut-off without draining.		
u)	Building Management System Compatibility :- To use a standard open source protocol for communication with a BMS, the UPS shall have MODBUS Card Inbuilt		

14. CABLES
HT cable

The specification covers the supply, installation and delivery to site of extruded sheathed 33 kV (E) grade, XLPE insulated Aluminum conductor cables.

The cable should conform to the latest applicable standards of Bureau of Indian Standards i.e. as per IS: 7098 Part II.

All cables shall be XLPE type and shall comply with the following requirements.

- Electrolyte Aluminum conductor shall be stranded, compacted and round.
- To relieve the electrical stresses, Semi conducting layer of XLPE shall be applied over the conductor.
- Insulation for cables shall be XLPE (Cross Linked polyethylene).The insulation shall be free of any air void and foreign material.
- A semi conducting layer shall be provided over the insulation to relieve electrical stresses.
- A metallic (Copper) tape shall provided over the semi conducting layer.
- Different cores in a cable shall be identified by colour coding as per IS.
- The Inner sheath shall be extruded type and shall be compatible with the insulation of cable. The inner sheath shall be with PVC compound type 'A',
- Armouring for the cables shall comprise G.I. strips/ wires.
- The outer sheath shall be of an extruded layer of PVC Compound compatible with the specified ambient and operating temperature of the cables. The sheath shall be resistant to water, ultra violet radiation, fungus, termite and rodent attacks. The outer sheath shall be of black color.
- Cables shall be subjected to routine and acceptance tests in accordance with IS: 7098 Test method shall conform to IS: 10810.
- Single core cable shall be considered as non-magnetic material either A2XFaY or 2XFaY type.

Cable schedule:

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
1	METER ROOM	HT ISOLATOR	1C X 240	6
1	HT ISOLATOR	33KV HT PANEL	1C X 240	6
1	33KV HT PANEL	2500kVA Transformer-1	1C X 150	3
2	33KV HT PANEL	2500kVA Transformer-2 (STAND BY)	1C X 150	3
3	33KV HT PANEL	2500kVA Transformer-3	1C X 150	3
	SUBSTATION			
1	2500kVA Transfomer-1	Main LT Panel Sec-1 (Bus Duct)	4000	1
2	2500kVA Transfomer-2	Main LT Panel Sec-3 (Bus Duct)	4000	1
4	2500kVA Transfomer-3 (STAND BY)	Main LT Panel Sec-2(Bus Duct)	4000	1
	DG SET			
1	1500 DG SET-1	SYNCHRONISATION PANEL (Bus Duct)	2500	1
2	1500 DG SET-2	SYNCHRONISATION PANEL (Bus Duct)	2500	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
3	1500 DG SET-3	SYNCHRONISATION PANEL (Bus Duct)	2500	1
4	1500 DG SET-4	SYNCHRONISATION PANEL (Bus Duct)	2500	1
1	SYNCHRONISATION PANEL	Main LT Panel (Bus Duct)	4000	1
2	SYNCHRONISATION PANEL	Main LT Panel (Bus Duct)	4000	1
	MAIN LT PANEL			
1	Main LT Panel Sec-1	(500A+600KVAR) HYBRID PANEL-1	3.5C X 300	4
2	Main LT Panel Sec-1	FEEDER PILLAR-1	3.5C X 50	1
3	Main LT Panel Sec-1	FEEDER PILLAR-2	3.5C X 50	1
4	Main LT Panel Sec-1	HOSPITAL BLOCK PANEL-1	1C X 400	14
5	Main LT Panel Sec-1	HVAC PLANT PANEL (F-1)	1C X 400	11
6	Main LT Panel Sec-1	SERVICE AREA MDB-PANEL	3.5C X 120	1
7	Main LT Panel Sec-1	PLUMBING PUMP ROOM PANEL	3.5C X 300	1
1	Main LT Panel Sec-1	(500A+600KVAR) HYBRID PANEL-2	3.5C X 300	4
2	Main LT Panel Sec-2	2BHK TOWER-A PANEL-1	3.5C X 300	2
3	Main LT Panel Sec-2	2BHK TOWER-A PANEL-2	3.5C X 300	2
4	Main LT Panel Sec-2	2BHK TOWER-B PANEL-1	3.5C X 300	2
5	Main LT Panel Sec-2	2BHK TOWER-B PANEL-2	3.5C X 300	2
6	Main LT Panel Sec-2	3BHK TOWER PANEL	3.5C X 300	2
7	Main LT Panel Sec-2	3BHK TOWER PANEL	3.5C X 300	2
8	Main LT Panel Sec-2	HOSPITAL BLOCK PANEL-2	1C X 400	14
1	Main LT Panel Sec-3	FIRE FIGHTING PANEL	3.5C X 300	1
2	Main LT Panel Sec-3	RESIDENCE & GUEST BLOCK PANEL	3.5C X 300	4
3	Main LT Panel Sec-3	NURSE HOSTEL PANEL	3.5C X 300	2
1	Main LT Panel Sec-1	(500A+600KVAR) HYBRID PANEL-3	3.5C X 300	4
2	Main LT Panel Sec-4	EV CHARGING PPANEL	3.5C X 95	1
3	Main LT Panel Sec-4	HVAC PLANT PANEL (F-2)	1C X 400	14
4	Main LT Panel Sec-4	STP ROOM - PANEL	3.5C X 150	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
5	Main LT Panel Sec-4	MAIN R&D/ACADEMIC	3.5C X 300	4
1	HOSPITAL BLOCK PANEL-1	KITCHEN PANEL	3.5C X 150	1
2	HOSPITAL BLOCK PANEL-1	LAUNDRY PANEL	3.5C X 185	1
1	HOSPITAL BLOCK PANEL-1	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	3.5C X 185	1
2	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-1	3C X 6	1
3	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-2	3C X 6	1
4	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-3	3C X 6	1
5	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-4	3C X 6	1
6	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-5	3C X 6	1
7	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-6	3C X 6	1
8	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-7	3C X 6	1
9	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-8	3C X 6	1
10	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-9	3C X 6	1
11	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-10	3C X 6	1
12	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-11	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
13	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-12	3C X 6	1
14	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-13	3C X 6	1
15	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-14	3C X 6	1
16	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-15	3C X 6	1
17	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-16	3C X 6	1
18	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-17	3C X 6	1
19	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-18	3C X 6	1
20	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-19	3C X 6	1
21	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-20	3C X 6	1
22	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-21	3C X 6	1
23	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-22	3C X 6	1
24	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-23	3C X 6	1
25	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-24	3C X 6	1
26	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AHU-25	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
27	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	HRW FAN	3C X 10	1
28	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	HRW FAN	3C X 10	1
29	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	CABINATE FAN	3C X 6	1
30	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AIR WASHER	3C X 6	1
31	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	AIR WASHER	3C X 6	1
32	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)	SCRUBBER	3C X 6	1
1	HOSPITAL BLOCK PANEL-1	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)	3.5C X 300	2
2	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)	VENTILATION PANEL GROUND FLOOR	3.5C X 35	1
3	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)	VENTILATION PANEL FIRST FLOOR	3.5C X 35	1
4	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)	VENTILATION PANEL SECOND FLOOR	3.5C X 35	1
5	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)	VENTILATION PANEL THIRD FLOOR	3.5C X 35	1
6	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)	VENTILATION PANEL FOURTH FLOOR	3.5C X 35	1
7	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)	VENTILATION PANEL FIFTH FLOOR	3.5C X 35	1
8	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)	VENTILATION PANEL SIXTH FLOOR	3.5C X 35	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
9	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	3.5C X 120	1
1	VENTILATION PANEL GROUND FLOOR	F/A FAN	3C X 10	1
2	VENTILATION PANEL GROUND FLOOR	F/A FAN	3C X 10	1
3	VENTILATION PANEL FIRST FLOOR	F/A FAN	3C X 10	1
4	VENTILATION PANEL FIRST FLOOR	F/A FAN	3C X 10	1
5	VENTILATION PANEL SECOND FLOOR	F/A FAN	3C X 10	1
6	VENTILATION PANEL SECOND FLOOR	F/A FAN	3C X 10	1
7	VENTILATION PANEL THIRD FLOOR	F/A FAN	3C X 10	1
8	VENTILATION PANEL THIRD FLOOR	F/A FAN	3C X 10	1
9	VENTILATION PANEL FOURTH FLOOR	F/A FAN	3C X 10	1
10	VENTILATION PANEL FOURTH FLOOR	F/A FAN	3C X 10	1
11	VENTILATION PANEL FIFTH FLOOR	F/A FAN	3C X 10	1
12	VENTILATION PANEL FIFTH FLOOR	F/A FAN	3C X 10	1
13	VENTILATION PANEL SIXTH FLOOR	F/A FAN	3C X 10	1
14	VENTILATION PANEL SIXTH FLOOR	F/A FAN	3C X 10	1
15	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-GF	3C X 6	1
16	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-GF	3C X 6	1
17	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-GF	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
18	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-GF	3C X 6	1
19	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-1F	3C X 6	1
20	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-1F	3C X 6	1
21	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-1F	3C X 6	1
22	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-2F	3C X 6	1
23	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-2F	3C X 6	1
24	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-3F	3C X 6	1
25	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-3F	3C X 6	1
26	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-3F	3C X 6	1
27	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-4F	3C X 6	1
28	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-4F	3C X 6	1
29	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-4F	3C X 6	1
30	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-5F	3C X 6	1
31	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-5F	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
32	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-5F	3C X 6	1
33	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-6F	3C X 6	1
34	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-6F	3C X 6	1
35	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	EX.FAN-6F	3C X 6	1
36	HRW PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	PRESSURIZATION PANEL HOSPITAL BLOCK (TOWER-1)	3.5C X 95	1
37	PRESSURIZATION PANEL HOSPITAL BLOCK (TOWER-1)	LIFT WELL PRESS. FAN	3C X 16	1
38	PRESSURIZATION PANEL HOSPITAL BLOCK (TOWER-1)	LIFT WELL PRESS. FAN	3C X 16	1
39	PRESSURIZATION PANEL HOSPITAL BLOCK (TOWER-1)	LIFT WELL PRESS. FAN	3C X 16	1
40	PRESSURIZATION PANEL HOSPITAL BLOCK (TOWER-1)	LIFT WELL PRESS. FAN	3C X 16	1
41	PRESSURIZATION PANEL HOSPITAL BLOCK (TOWER-1)	STAIRCASE PRESS. FAN	3C X 16	1
42	PRESSURIZATION PANEL HOSPITAL BLOCK (TOWER-1)	LIFT LOBBY PRESS. FAN	3C X 16	1
1	HOSPITAL BLOCK PANEL-1	Medical EUIP. Panel (LHS) GROUND FLOOR	1C X 300	11
1	Medical EUIP. Panel (LHS) GROUND FLOOR	CT. SCAN-1	3.5C X 185	2
2	Medical EUIP. Panel (LHS) GROUND FLOOR	MRI	3.5C X 300	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
3	Medical EUIP. Panel (LHS) GROUND FLOOR	X-RAY-1	3.5C X 185	1
4	Medical EUIP. Panel (LHS) GROUND FLOOR	CSSD	3.5C X 240	2
1	HOSPITAL BLOCK PANEL-1	1250A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	1C X 300	14
2	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) GR.FL.	3.5C X 120	1
3	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 1F	3.5C X 120	1
4	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 2F	3.5C X 120	1
5	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 3F	3.5C X 120	1
6	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 4F	3.5C X 95	1
7	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 5F	3.5C X 95	1
8	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 6F	3.5C X 95	1
1	HOSPITAL BLOCK PANEL-2	1250A RISING MAIN (S) (L+P) HOSPITAL BLOCK(G+6)-LHS	1C X 300	14
1	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) GR.FL.	3.5C X 120	1
2	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 1F	3.5C X 120	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
3	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 2F	3.5C X 120	1
4	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 3F	3.5C X 120	1
5	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 4F	3.5C X 95	1
6	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 5F	3.5C X 95	1
7	1600A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-LHS	MDB(L+P) 6F	3.5C X 95	1
1	HOSPITAL BLOCK PANEL-1	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	1C X 300	11
2	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) GR.FL.	3.5C X 70	1
3	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 1F	3.5C X 70	1
4	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 2F	3.5C X 70	1
5	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 3F	3.5C X 70	1
6	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 4F	3.5C X 70	1
7	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 5F	3.5C X 70	1
8	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 6F	3.5C X 70	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
1	HOSPITAL BLOCK PANEL-2	1000A RISING MAIN (S) (L+P) HOSPITAL BLOCK(G+6)-RHS	1C X 300	11
1	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) GR.FL.	3.5C X 70	1
2	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 1F	3.5C X 70	1
3	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 2F	3.5C X 70	1
4	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 3F	3.5C X 70	1
5	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 4F	3.5C X 70	1
6	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 5F	3.5C X 70	1
7	1000A RISING MAIN (W) (L+P) HOSPITAL BLOCK(G+6)-RHS	MDB(L+P) 6F	3.5C X 70	1
8	HVAC PLANT PANEL (F-1)	HOT WATER GENERATOR- 1(S) (HEATER)	3.5C X 300	3
9	HVAC PLANT PANEL (F-1)	HOT WATER GENERATOR- 1(W) (HEATER)	3.5C X 300	3
10	HVAC PLANT PANEL (F-1)	PRIMARY WATER PUMP(S)	3.5C X 50	1
11	HVAC PLANT PANEL (F-1)	PRIMARY WATER PUMP(W)	3.5C X 50	1
12	HVAC PLANT PANEL (F-1)	CONDENSOR WATER PUMP(S)	3.5C X 50	2
13	HVAC PLANT PANEL (F-1)	CONDENSOR WATER PUMP(W)	3.5C X 50	2
14	HVAC PLANT PANEL (F-1)	PRIMARY WATER PUMP(W)- OT	3.5C X 35	1
15	HVAC PLANT PANEL (F-1)	CONDENSOR WATER PUMP(S)-OT	3C X 10	1
16	HVAC PLANT PANEL (F-1)	HOT WATER PUMP-1(S)-R/H	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
17	HVAC PLANT PANEL (F-1)	HOT WATER PUMP-1(W)-R/H	3C X 6	1
18	HVAC PLANT PANEL (F-1)	COOLING TOWER (S)	3C X 16	1
19	HVAC PLANT PANEL (F-1)	COOLING TOWER (W)	3C X 16	1
20	HVAC PLANT PANEL (F-1)	HOT WATER GENERATOR-1(S) (OT)	3.5C X 300	1
21	HVAC PLANT PANEL (F-1)	CHILLER-1 (S)	3.5C X 300	2
22	HVAC PLANT PANEL (F-1)	CHILLER-2 (W)	3.5C X 300	2
23	HVAC PLANT PANEL (F-1)	CHILLER-3 (W)	3.5C X 300	2
24	HVAC PLANT PANEL (F-2)	HOT WATER GENERATOR-1(W) (HEATER)	3.5C X 300	3
25	HVAC PLANT PANEL (F-2)	PRIMARY WATER PUMP(W)	3.5C X 50	1
26	HVAC PLANT PANEL (F-2)	PRIMARY WATER PUMP(W)	3.5C X 50	1
27	HVAC PLANT PANEL (F-2)	CONDENSOR WATER PUMP(W)	3.5C X 35	2
28	HVAC PLANT PANEL (F-2)	CONDENSOR WATER PUMP(W)	3.5C X 35	2
29	HVAC PLANT PANEL (F-2)	PRIMARY WATER PUMP(S)-OT	3C X 10	1
30	HVAC PLANT PANEL (F-2)	CONDENSOR WATER PUMP(W)-OT	3C X 10	2
31	HVAC PLANT PANEL (F-2)	HOT WATER PUMP-1(W)-R/H	3C X 6	1
32	HVAC PLANT PANEL (F-2)	COOLING TOWER (W)	3C X 16	1
33	HVAC PLANT PANEL (F-2)	COOLING TOWER (W)	3C X 16	1
34	HVAC PLANT PANEL (F-2)	HOT WATER GENERATOR-1(W) (OT)	3.5C X 300	1
35	HVAC PLANT PANEL (F-2)	CHILLER-4 (W)	3.5C X 300	2
36	HVAC PLANT PANEL (F-2)	CHILLER-5 (W)	3.5C X 150	1
37	HVAC PLANT PANEL (F-2)	HOT WATER GENERATOR-1(W) (OT)	3.5C X 185	1
1	HOSPITAL BLOCK PANEL-2	MAIN AHU PANEL HOSPITAL BLOCK (TOWER-2)	3.5C X 300	1
2	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-1	3C X 6	1
3	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-2	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
4	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-3	3C X 6	1
5	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-4	3C X 6	1
6	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-5	3C X 6	1
7	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-6	3C X 6	1
8	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-7	3C X 6	1
9	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-8	3C X 6	1
10	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-9	3C X 6	1
11	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	AHU-10	3C X 6	1
12	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)	HRW PANEL SERVICE FLOOR	3C X 16	1
13	HRW PANEL SERVICE FLOOR	HRW	3C X 10	1
14	HRW PANEL SERVICE FLOOR	HRW	3C X 10	1
1	HOSPITAL BLOCK PANEL-2	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-2)	3.5C X 240	2
2	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-2)	VENTILATION PANEL -GF	3.5C X 35	1
3	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-2)	VENTILATION PANEL -1F	3.5C X 35	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
4	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-2)	VENTILATION PANEL -2F	3.5C X 35	1
5	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-2)	VENTILATION PANEL -3F	3.5C X 35	1
6	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-2)	VENTILATION PANEL -4F	3.5C X 35	1
7	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-2)	VENTILATION PANEL -5F	3.5C X 35	1
8	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-2)	VENTILATION PANEL -6F	3.5C X 35	1
9	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-2)	VENT.PANEL-HOSPITAL BLOCK (TOWER-1) Terrace floor	3.5C X 120	1
10	VENTILATION PANEL GROUND FLOOR	F/A FAN	3C X 10	1
11	VENTILATION PANEL GROUND FLOOR	F/A FAN	3C X 10	1
12	VENTILATION PANEL FIRST FLOOR	F/A FAN	3C X 10	1
13	VENTILATION PANEL FIRST FLOOR	F/A FAN	3C X 10	1
14	VENTILATION PANEL SECOND FLOOR	F/A FAN	3C X 10	1
15	VENTILATION PANEL SECOND FLOOR	F/A FAN	3C X 10	1
16	VENTILATION PANEL THIRD FLOOR	F/A FAN	3C X 10	1
17	VENTILATION PANEL THIRD FLOOR	F/A FAN	3C X 10	1
18	VENTILATION PANEL FOURTH FLOOR	F/A FAN	3C X 10	1
19	VENTILATION PANEL FOURTH FLOOR	F/A FAN	3C X 10	1
20	VENTILATION PANEL FIFTH FLOOR	F/A FAN	3C X 10	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
21	VENTILATION PANEL FIFTH FLOOR	F/A FAN	3C X 10	1
22	VENTILATION PANEL SIXTH FLOOR	F/A FAN	3C X 10	1
23	VENTILATION PANEL SIXTH FLOOR	F/A FAN	3C X 10	1
24	VENT.PANEL-HOSPITAL BLOCK (TOWER-2) Terrace floor	EX.FAN	3C X 6	1
25	VENT.PANEL-HOSPITAL BLOCK (TOWER-2) Terrace floor	EX.FAN	3C X 6	1
26	VENT.PANEL-HOSPITAL BLOCK (TOWER-2) Terrace floor	EX.FAN	3C X 6	1
27	VENT.PANEL-HOSPITAL BLOCK (TOWER-2) Terrace floor	EX.FAN	3C X 6	1
28	VENT.PANEL-HOSPITAL BLOCK (TOWER-2) Terrace floor	EX.FAN	3C X 6	1
29	VENT.PANEL-HOSPITAL BLOCK (TOWER-2) Terrace floor	EX.FAN	3C X 6	1
30	VENT.PANEL-HOSPITAL BLOCK (TOWER-2) Terrace floor	EX.FAN	3C X 6	1
31	VENT.PANEL-HOSPITAL BLOCK (TOWER-2) Terrace floor	EX.FAN	3C X 6	1
32	VENT.PANEL-HOSPITAL BLOCK (TOWER-2) Terrace floor	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	3.5C X 70	1
33	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT WELL PRESS. FAN	3C X 6	1
34	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT WELL PRESS. FAN	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
35	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT WELL PRESS. FAN	3C X 6	1
36	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT WELL PRESS. FAN	3C X 6	1
37	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT WELL PRESS. FAN	3C X 6	1
38	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT WELL PRESS. FAN	3C X 6	1
39	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT WELL PRESS. FAN	3C X 6	1
40	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT WELL PRESS. FAN	3C X 6	1
41	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	STAICASE PRESS. FAN	3C X 6	1
42	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT LOBBY PRESS. FAN	3C X 6	1
43	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT LOBBY PRESS. FAN	3C X 6	1
44	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT LOBBY PRESS. FAN	3C X 6	1
45	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-2)	LIFT LOBBY PRESS. FAN	3C X 6	1
1	HOSPITAL BLOCK PANEL-2	MAIN AHU PANEL HOSPITAL BLOCK (TOWER-3)	3.5C X 150	1
2	MAIN AHU PANEL HOSPITAL BLOCK (TOWER-3)	AHU PANEL-1 SERVICE FLOOR	3.5C X 240	1
3	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
4	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
5	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
6	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
7	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
8	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
9	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
10	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
11	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
12	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
13	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
14	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
15	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
16	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
17	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
18	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
19	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
20	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
21	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
22	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
23	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
24	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
25	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
26	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
27	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
28	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
29	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
30	AHU PANEL-1 SERVICE FLOOR	AHU	3C X 6	1
31	AHU PANEL-1 SERVICE FLOOR	HRW	3C X 16	1
32	AHU PANEL-1 SERVICE FLOOR	HRW	3C X 16	1
33	AHU PANEL-1 SERVICE FLOOR	AIR WASHER	3C X 16	1
34	MAIN AHU PANEL HOSPITAL BLOCK (TOWER-3)	AHU PANEL-2 TERRACE	3.5C X 70	1
35	AHU PANEL-2 TERRACE	AHU	3C X 6	1
36	AHU PANEL-2 TERRACE	AHU	3C X 6	1
37	AHU PANEL-2 TERRACE	AHU	3C X 6	1
38	AHU PANEL-2 TERRACE	AHU	3C X 6	1
39	AHU PANEL-2 TERRACE	AHU	3C X 6	1
40	AHU PANEL-2 TERRACE	AHU	3C X 6	1
41	AHU PANEL-2 TERRACE	AHU	3C X 6	1
42	AHU PANEL-2 TERRACE	AHU	3C X 6	1
43	AHU PANEL-2 TERRACE	AHU	3C X 6	1
44	AHU PANEL-2 TERRACE	AHU	3C X 6	1
45	AHU PANEL-2 TERRACE	AHU	3C X 6	1
46	AHU PANEL-2 TERRACE	AHU	3C X 6	1
47	AHU PANEL-2 TERRACE	AHU	3C X 6	1
48	AHU PANEL-2 TERRACE	AHU	3C X 6	1
49	AHU PANEL-2 TERRACE	HRW	3C X 6	1
1	HOSPITAL BLOCK PANEL-2	MAIN VENTILATION PANEL HOSPITAL BLOCK (TOWER-3)	3.5C X 185	2

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
2	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-3)	VENTILATION PANEL -GF	3.5C X 35	1
3	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-3)	VENTILATION PANEL -1F	3.5C X 35	1
4	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-3)	VENTILATION PANEL -2F	3.5C X 35	1
5	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-3)	VENTILATION PANEL -3F	3.5C X 35	1
6	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-3)	VENTILATION PANEL -4F	3.5C X 35	1
7	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-3)	VENTILATION PANEL -5F	3.5C X 35	1
8	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-3)	VENTILATION PANEL -6F	3.5C X 35	1
9	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-3)	FAN SECTION FOR EXH. (NORMAL) TERRACE	3.5C X 35	1
10	MAIN VENTILATION PANEL - HOSPITAL BLOCK (TOWER-3)	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	3.5C X 70	1
11	VENTILATION PANEL GROUND FLOOR	F/A FAN	3C X 10	1
12	VENTILATION PANEL GROUND FLOOR	F/A FAN	3C X 10	1
13	VENTILATION PANEL FIRST FLOOR	F/A FAN	3C X 10	1
14	VENTILATION PANEL FIRST FLOOR	F/A FAN	3C X 10	1
15	VENTILATION PANEL SECOND FLOOR	F/A FAN	3C X 10	1
16	VENTILATION PANEL SECOND FLOOR	F/A FAN	3C X 10	1
17	VENTILATION PANEL THIRD FLOOR	F/A FAN	3C X 10	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
18	VENTILATION PANEL THIRD FLOOR	F/A FAN	3C X 10	1
19	VENTILATION PANEL FOURTH FLOOR	F/A FAN	3C X 10	1
20	VENTILATION PANEL FOURTH FLOOR	F/A FAN	3C X 10	1
21	VENTILATION PANEL FIFTH FLOOR	F/A FAN	3C X 10	1
22	VENTILATION PANEL FIFTH FLOOR	F/A FAN	3C X 10	1
23	VENTILATION PANEL SIXTH FLOOR	F/A FAN	3C X 10	1
24	VENTILATION PANEL SIXTH FLOOR	F/A FAN	3C X 10	1
25	FAN SECTION FOR EXH. (NORMAL) TERRACE	FAN SECTION	3C X 10	1
26	FAN SECTION FOR EXH. (NORMAL) TERRACE	FAN SECTION	3C X 10	1
27	FAN SECTION FOR EXH. (NORMAL) TERRACE	FAN SECTION	3C X 10	1
28	FAN SECTION FOR EXH. (NORMAL) TERRACE	FAN SECTION	3C X 10	1
29	FAN SECTION FOR EXH. (NORMAL) TERRACE	FAN SECTION	3C X 10	1
30	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
31	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
32	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
33	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
34	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
35	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
36	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
37	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
38	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
39	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
40	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
41	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
42	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	EX.FAN	3C X 6	1
43	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-3)	4C X 25	1
44	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-3)	LIFT WELL PRESS. FAN	3C X 10	1
45	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-3)	LIFT WELL PRESS. FAN	3C X 10	1
46	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-3)	LIFT WELL PRESS. FAN	3C X 10	1
47	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-3)	LIFT WELL PRESS. FAN	3C X 10	1
48	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-3)	STAIRCASE PRESS. FAN	3C X 16	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
49	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-3)	LIFT LOBBY PRESS. FAN	3C X 10	1
1	HOSPITAL BLOCK PANEL-2	MEDICAL EQUIP. PANEL-RHS	3.5C X 240	3
2	MEDICAL EQUIP. PANEL-RHS	CT.SCAN-2	3.5C X 185	2
3	MEDICAL EQUIP. PANEL-RHS	X-RAY-3	3.5C X 185	1
4	MEDICAL EQUIP. PANEL-RHS	X-RAY-2	3.5C X 185	1
1	HOSPITAL BLOCK PANEL-1	UPS-INPUT PANEL (OPD,EQUIP,OFFICE)	3.5C X 300	2
1	HOSPITAL BLOCK PANEL-2	UPS-INPUT PANEL (OPD,EQUIP,OFFICE)	3.5C X 300	2
2	UPS-INPUT PANEL (OPD,EQUIP,OFFICE)	UPS	1C X 300	4
3	UPS-INPUT PANEL (OPD,EQUIP,OFFICE)	UPS	1C X 300	4
4	UPS	UPS-OUTPUT PANEL (OPD,EQUIP,OFFICE)	1C X 300	4
5	UPS	UPS-OUTPUT PANEL (OPD,EQUIP,OFFICE)	1C X 300	4
6	UPS-OUTPUT PANEL (OPD,EQUIP,OFFICE)	300A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-LHS	3.5C X 185	4
7	UPS-OUTPUT PANEL (OPD,EQUIP,OFFICE)	300A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-LHS	3.5C X 185	3
8	UPS-OUTPUT PANEL (OPD,EQUIP,OFFICE)	200A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-LHS	3.5C X 185	4
9	UPS-OUTPUT PANEL (OPD,EQUIP,OFFICE)	200A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-LHS	3.5C X 185	3
10	300A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) GR.FL.	3.5C X 70	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
11	300A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 1F	3.5C X 70	1
12	300A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 2F	3.5C X 70	1
13	300A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 3F	3.5C X 70	1
14	300A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 4F	3.5C X 70	1
15	300A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 5F	3.5C X 70	1
16	300A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 6F	3.5C X 70	1
17	300A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) GR.FL.	3.5C X 70	1
18	300A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 1F	3.5C X 50	1
19	300A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 2F	3.5C X 50	1
20	300A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 3F	3.5C X 50	1
21	300A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 4F	3.5C X 50	1
22	300A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 5F	3.5C X 50	1
23	300A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-LHS	MDB(UPS) 6F	3.5C X 50	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
24	200A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) GR.FL.	3.5C X 70	1
25	200A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 1F	3.5C X 70	1
26	200A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 2F	3.5C X 70	1
27	200A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 3F	3.5C X 70	1
28	200A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 4F	3.5C X 70	1
29	200A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 5F	3.5C X 70	1
30	200A RISING MAIN (W) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 6F	3.5C X 70	1
31	200A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) GR.FL.	3.5C X 70	1
32	200A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 1F	3.5C X 50	1
33	200A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 2F	3.5C X 50	1
34	200A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 3F	3.5C X 50	1
35	200A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 4F	3.5C X 50	1
36	200A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 5F	3.5C X 50	1
37	200A RISING MAIN (S) (UPS) HOSPITAL BLOCK(G+6)-RHS	MDB(UPS) 6F	3.5C X 50	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
1	HOSPITAL BLOCK PANEL-1	UPS-INPUT PANEL (OT)	3.5C X 240	1
2	UPS-INPUT PANEL (OT)	UPS	1C X 185	4
3	UPS	UPS-OUTPUT PANEL (OT)	1C X 185	4
1	HOSPITAL BLOCK PANEL-2	UPS-INPUT PANEL (OT)	3.5C X 240	1
2	UPS-INPUT PANEL (OT)	UPS	1C X 185	4
3	UPS	UPS-OUTPUT PANEL (OT)	1C X 185	4
4	UPS-OUTPUT PANEL (OT)	CATH LAB -OT	3.5C X 185	2
5	UPS-OUTPUT PANEL (OT)	MINOR -OT PANEL	3.5C X 185	2
6	UPS-OUTPUT PANEL (OT)	GYNAE -OT	3.5C X 185	2
7	UPS-OUTPUT PANEL (OT)	MAJOR -OT PANEL	3.5C X 185	2
1	HOSPITAL BLOCK PANEL-1	LIFT PANEL (HOSPITAL BLOCK)	3.5C X 300	2
1	HOSPITAL BLOCK PANEL-2	UPS-LIFT INPUT PANEL (HOSPITAL BLOCK)	3.5C X 300	2
2	UPS-LIFT INPUT PANEL (HOSPITAL BLOCK)	UPS	1C X 300	4
3	UPS	UPS-LIFT OUTPUT PANEL	1C X 300	4
4	UPS-LIFT OUTPUT PANEL	LIFT PANEL (HOSPITAL BLOCK)	1C X 300	4
5	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
6	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
7	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
8	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
9	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
10	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
11	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
12	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
13	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
14	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
15	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
16	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
17	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
18	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
19	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
20	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
21	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
22	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
23	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
24	LIFT PANEL (HOSPITAL BLOCK)	LIFT	3C X 25	1
1	MAIN R&D/ACADEMIC BLOCK PANEL (G+6)	LIFT PANEL (ACADMIC BLOCK)	3.5C X 120	1
2	MAIN R&D/ACADEMIC BLOCK PANEL (G+6)	RISING MAINS (LIGHT+POWER) R&D /ACADEMIC BLOCK(G+6)	3.5C X 300	2
3	MAIN R&D/ACADEMIC BLOCK PANEL (G+6)	MAIN AHU PANEL ACADMIC BLOCK	3.5C X 120	1
4	MAIN R&D/ACADEMIC BLOCK PANEL (G+6)	UPS-ACADMIC INPUT PANEL	3.5C X 150	1
5	MAIN R&D/ACADEMIC BLOCK PANEL (G+6)	VENT.PANEL-Terrace floor	4C X 25	1
6	LIFT PANEL (ACADMIC BLOCK)	LIFT -1	3C X 16	1
7	LIFT PANEL (ACADMIC BLOCK)	LIFT -2	3C X 16	1
8	LIFT PANEL (ACADMIC BLOCK)	LIFT -3	3C X 16	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
9	LIFT PANEL (ACADMIC BLOCK)	LIFT -4	3C X 16	1
10	LIFT PANEL (ACADMIC BLOCK)	LIFT -5	3C X 16	1
11	LIFT PANEL (ACADMIC BLOCK)	LIFT -6	3C X 16	1
12	400A RISING MAINS (LIGHT+POWER) R&D /ACADEMIC BLOCK(G+6)	MDB(L+P) GR.FL.	3.5C X 50	1
13	400A RISING MAINS (LIGHT+POWER) R&D /ACADEMIC BLOCK(G+6)	MDB(L+P) 1F	3.5C X 50	1
14	400A RISING MAINS (LIGHT+POWER) R&D /ACADEMIC BLOCK(G+6)	MDB(L+P) 2F	3.5C X 50	1
15	400A RISING MAINS (LIGHT+POWER) R&D /ACADEMIC BLOCK(G+6)	MDB(L+P) 3F	3.5C X 50	1
16	400A RISING MAINS (LIGHT+POWER) R&D /ACADEMIC BLOCK(G+6)	MDB(L+P) 4F	3.5C X 50	1
17	MAIN AHU PANEL ACADMIC BLOCK	AHU MDB-GF	3.5C X 35	1
18	MAIN AHU PANEL ACADMIC BLOCK	AHU MDB-1F	3.5C X 35	1
19	MAIN AHU PANEL ACADMIC BLOCK	AHU MDB-2F	3.5C X 35	1
20	MAIN AHU PANEL ACADMIC BLOCK	AHU MDB-3F	3.5C X 35	1
21	MAIN AHU PANEL ACADMIC BLOCK	AHU MDB-TERRACE	3.5C X 35	1
22	MAIN AHU PANEL ACADMIC BLOCK	AHU MDB-TERRACE	3.5C X 35	1
23	AHU MDB-GF	AHU	3C X 10	1
24	AHU MDB-GF	AHU	3C X 10	1
25	AHU MDB-GF	AHU	3C X 10	1
26	AHU MDB-1F	AHU	3C X 10	1
27	AHU MDB-1F	AHU	3C X 10	1
28	AHU MDB-2F	AHU	3C X 10	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
29	AHU MDB-2F	AHU	3C X 10	1
30	AHU MDB-3F	AHU	3C X 10	1
31	AHU MDB-3F	AHU	3C X 10	1
32	AHU MDB-4F	AHU	3C X 10	1
33	AHU MDB-4F	AHU	3C X 10	1
34	AHU MDB-TERRACE	AHU	3C X 10	1
35	AHU MDB-TERRACE	AHU	3C X 10	1
36	UPS-ACADMIC INPUT PANEL	UPS	1C X 120	4
37	UPS	UPS-OUTPUT PANEL (ACADEMIC BLOCK)	1C X 120	4
38	UPS-OUTPUT PANEL (ACADEMIC BLOCK)	200A RISING MAINS (UPS) R&D BLOCK	3.5C X 150	1
39	200A RISING MAINS (UPS) R&D BLOCK	MDB(UPS) GR.FL.	3.5C X 50	1
40	200A RISING MAINS (UPS) R&D BLOCK	MDB(UPS) 1F	3.5C X 50	1
41	200A RISING MAINS (UPS) R&D BLOCK	MDB(UPS) 2F	3.5C X 50	1
42	200A RISING MAINS (UPS) R&D BLOCK	MDB(UPS) 3F	3.5C X 50	1
43	200A RISING MAINS (UPS) R&D BLOCK	MDB(UPS) 4F	3.5C X 50	1
44	VENT.PANEL-Terrace floor	EX.FAN	3C X 6	1
45	VENT.PANEL-Terrace floor	EX.FAN	3C X 6	1
46	VENT.PANEL-Terrace floor	EX.FAN	3C X 6	1
47	VENT.PANEL-Terrace floor	EX.FAN	3C X 6	1
48	VENT.PANEL-Terrace floor	EX.FAN	3C X 6	1
49	VENT.PANEL-Terrace floor	HRW,	3C X 6	1
50	VENT.PANEL-Terrace floor	HRW,	3C X 6	1
1	RESIDENCE & GUEST BLOCK PANEL			
2	RESIDENCE & GUEST BLOCK PANEL	MDB(L+P) GR.FL.	3.5C X 50	1
3	RESIDENCE & GUEST BLOCK PANEL	MDB(L+P) 1F	3.5C X 50	1
4	RESIDENCE & GUEST BLOCK PANEL	MDB(L+P) 2F	3.5C X 50	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
5	RESIDENCE & GUEST BLOCK PANEL	MDB(L+P) 3F	3.5C X 50	1
6	RESIDENCE & GUEST BLOCK PANEL	MDB(L+P) 4F	3.5C X 50	1
7	RESIDENCE & GUEST BLOCK PANEL	MDB(L+P) 5F	3.5C X 50	1
8	RESIDENCE & GUEST BLOCK PANEL	MDB(L+P) 6F	3.5C X 50	1
9	RESIDENCE & GUEST BLOCK PANEL	LIFT PANEL (GUEST HOUSE)	3.5C X 50	1
10	MDB(L+P) 6F	LIFT WELL PRESSURIZATION FAN	3C X 6	1
11	MDB(L+P) 6F	LIFT WELL PRESSURIZATION FAN	3C X 6	1
12	MDB(L+P) 6F	LIFT WELL PRESSURIZATION FAN	3C X 6	1
13	MDB(L+P) 6F	LIFT WELL PRESSURIZATION FAN	3C X 6	1
14	LIFT PANEL (GUEST HOUSE)	LIFT-1	3C X 25	1
15	LIFT PANEL (GUEST HOUSE)	LIFT-2	3C X 25	1
16	LIFT PANEL (GUEST HOUSE)	LIFT-3	3C X 25	1
1	NURSE HOSTEL PANEL			
2	NURSE HOSTEL PANEL	MDB(L+P) GR.FL.	3.5C X 50	1
3	NURSE HOSTEL PANEL	MDB(L+P) 1F	3.5C X 50	1
4	NURSE HOSTEL PANEL	MDB(L+P) 2F	3.5C X 50	1
5	NURSE HOSTEL PANEL	MDB(L+P) 3F	3.5C X 50	1
6	NURSE HOSTEL PANEL	MDB(L+P) 4F	3.5C X 50	1
7	NURSE HOSTEL PANEL	MDB(L+P) 5F	3.5C X 50	1
8	NURSE HOSTEL PANEL	MDB(L+P) 6F	3.5C X 50	1
9	NURSE HOSTEL PANEL	LIFT PANEL-NURSE HOSTEL	3.5C X 50	1
10	MDB(L+P) 6F	LIFT WELL PRESSURIZATION FAN	3C X 6	1
11	MDB(L+P) 6F	LIFT WELL PRESSURIZATION FAN	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
12	MDB(L+P) 6F	LIFT WELL PRESSURIZATION FAN	3C X 6	1
13	LIFT PANEL-NURSE HOSTEL	LIFT -1	3C X 25	1
14	LIFT PANEL-NURSE HOSTEL	LIFT -2	3C X 25	1
1	2BHK TOWER-A PANEL-1			
2	2BHK TOWER-A PANEL-1	CADB-GF	3.5C X 35	1
3	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
4	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
5	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
6	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
7	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
8	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
9	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
10	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
11	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
12	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
13	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
14	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
15	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
16	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
17	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
18	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
19	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
20	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
21	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
22	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
23	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
24	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
25	2BHK TOWER-A PANEL-1	LIFT PANEL-2BHK TOWER-A (G+10)	3.5C X 50	1
26	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT -1	3C X 25	1
27	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT -2	3C X 25	1
28	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT WELL PRESSURIZATION FAN	3C X 6	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
29	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT WELL PRESSURIZATION FAN	3C X 6	1
30	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT WELL PRESSURIZATION FAN	3C X 6	1
1	2BHK TOWER-A PANEL-2			
2	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
3	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
4	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
5	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
6	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
7	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
8	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
9	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
10	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
11	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
12	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
13	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
14	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
15	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
16	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
17	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
18	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
19	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
20	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
21	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
22	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
23	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
1	2BHK TOWER-B PANEL-1			
2	2BHK TOWER-A PANEL-1	CADB-GF	3.5C X 35	1
3	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
4	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
5	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
6	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
7	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
8	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
9	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
10	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
11	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
12	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
13	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
14	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
15	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
16	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
17	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
18	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
19	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
20	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
21	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
22	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
23	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
24	2BHK TOWER-A PANEL-1	2BHK FLAT	3.5C X 35	1
25	2BHK TOWER-A PANEL-1	LIFT PANEL-2BHK TOWER-A (G+10)	3.5C X 50	1
26	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT -1	3C X 25	1
1	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT -2	3C X 25	1
27	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT WELL PRESSURIZATION FAN	3C X 6	1
2	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT WELL PRESSURIZATION FAN	3C X 6	1
28	LIFT PANEL-2BHK TOWER-A (G+10)	LIFT WELL PRESSURIZATION FAN	3C X 6	1
1	2BHK TOWER-B PANEL-2			
2	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
3	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
4	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
5	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
6	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
7	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
8	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
9	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
10	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
11	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
12	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
13	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
14	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
15	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
16	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
17	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
18	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
19	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
20	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
21	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
22	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
23	2BHK TOWER-A PANEL-2	2BHK FLAT	3.5C X 35	1
1	3BHK TOWER(G+10)			
2	3BHK TOWER(G+10)	CADB-GF	3.5C X 35	1
3	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
4	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
5	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
6	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
7	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
8	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
9	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
10	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
11	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
12	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
13	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
14	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
15	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
16	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
17	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
18	3BHK TOWER(G+10)	3BHK FLAT	3.5C X 35	1
19	3BHK TOWER(G+10)	LIFT PANEL-3BHK TOWER (G+10)	3.5C X 50	1
20	LIFT PANEL-3BHK TOWER (G+10)	LIFT -1	3C X 25	1
21	LIFT PANEL-3BHK TOWER (G+10)	LIFT -2	3C X 25	1
22	LIFT PANEL-3BHK TOWER (G+10)	LIFT WELL PRESSURIZATION FAN	3C X 6	1
23	LIFT PANEL-3BHK TOWER (G+10)	LIFT WELL PRESSURIZATION FAN	3C X 6	1
24	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
25	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1

S. No.	From	To	Cable Size in (Sq.mm)	No. of Runs Selected
26	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
27	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
28	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
29	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
30	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
31	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
32	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
33	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
34	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
35	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
36	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
37	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
38	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1
39	METER PANEL-2 (3BHK TOWER)	3BHK FLAT	3.5C X 35	1

Note: The contractor shall prepare the cable schedule as per the GFC drawings before execution. In case of any discrepancy between the above schedule and schedule prepared as per GFC drawings, the latter shall be considered as correct and the contractor shall carry out the work as per that schedule without any extra cost.

TESTING, MANUFACTURER'S TESTS, PRE-COMMISSIONING TESTS AND COMPLETE COMMISSIONING

The General intent of this specification is to mention the relevant tests to be done and furnished to the Engineer-in-Charge by the Contractor. These are guidelines. However the Contractor shall carry out all such tests and complete all formalities as per relevant Indian Standard Specifications, Fire Insurance Requirements and/or Electricity Rules and Regulations as per Government Gazette and Publications.

Testing of Equipment:

All equipment before installing on the site work shall be tested and all such results produced to the Engineer-in-Charge. Nothing shall absolve the Contractor from re-

performing any tests that the Contractor may be called upon specifically by the Engineer-in-Charge or Supply Company or electrical inspector. All equipment shall be tested jointly with the Engineer-in-Charge as required by various sections of the specifications and test data shall be furnished as required.

Pre-commissioning Tests:

All rules, regulations and requirements of Electrical, Government or Local Authorities and of Indian Standard Specifications and/or Rules and Regulations stated in Indian Electricity Act shall be strictly complied.

On completion of erection the contractor shall clean all the equipment thoroughly and inspect the entire installation for correctness and shall furnish a report of completion to the Engineer-in-Charge. Pre-commissioning tests shall commence only on approval of this report by the Engineer-in-Charge.

All tests and the certification thereof shall only be carried out by those authorized, skilled, experienced and certified permit holders of the Supervisor Category of State Government's Industries and Labour Department. No unauthorized personnel shall ever carry out any such tests as stated herein under.

Mechanical Operational tests for all movable parts of switchgears, breakers, tripping devices etc.

- Phase sequence tests at all the relevant points for connecting correct R, Y and B as per the supply utility sequence.
- All Panels to be tested for interlocks, control tripping and breakers to be tested for sequential tripping.
- Continuity tests shall be done for noting any short circuits and/or earthing of phases.

Earthing tests for continuity of Earth by earth megger, on L.V. side. The earth resistance values shall not exceed 5 ohm.

15. LIFT

1.0 GENERAL

The equipment and installation covered by these specifications and drawings shall conform to codes of practice and highest standards of workmanship and materials. This work shall be done in accordance with the provisions of the Lifts Act, CPWD 2003 and Amendment No.1 and subsequent provisions, as also any state or local Act in force and latest Indian Standard 14665, 15330.

The Electrical wiring shall strictly comply with IS:732 and the entire installation shall be in accordance with the Indian Electricity Act 2003 and Indian Electricity Rules 1956 as amended to-date. The electrical works shall also conform to CPWD General Specifications for Electrical works Part - I (Internal) 2023 and Part - II (External) 2023 as amended up to date wherever relevant.

The Contractor shall follow all statutory requirements as well as best trade practices in the manufacture & installation of elevators. The Contractor shall arrange to obtain the approval of the Inspectorate of Lifts for commissioning of the Elevators and handover for operation after satisfactory tests.

2.0 TRACTION MACHINE AND DRIVE

The motor shall be controlled by a variable voltage variable frequency (V.V.V.F.) micro-processor control system which shall control and monitor every aspect of elevator operation at all stages of the car motion cycle on real time basis.

The A.C. V.V.V.F. drive system shall control A.C. voltage and frequency concurrently with the hoist motor to regulate the elevator's actual performance to match closely the ideal speed pattern to obtain maximum efficiency of operation and provide a very smooth ride.

Frequency shall range fully between zero and rated value.

The Controller shall be provided with a self-diagnostic programme to keep downtime to a minimum possible.

The controller shall intelligently adjust door times in response to car calls, hall calls and "Door Open" button operation.

An Inspector's changeover switch and set of test buttons shall be provided in the controller. Operation of the Inspector's changeover switch shall make both the car and landing buttons inoperative and permit the elevator to be operated in either direction from machine room for test purposes by pressing corresponding test buttons in the controller. It shall not however interfere with the emergency stop switches inside the car or on the top of the car.

3.0 SAFETY

In the addition to other specifications the Elevator shall be provided with safety devices as follows:-

- Safety gear on car so that in the event of rope breaking or loosening the car will be brought to rest immediately by means of grips on the guides.
- The over speeding car shall be automatically brought to a gradual stop on guide rails and power supply to the hoist motor shall be switched off.
- Car gate lock so that in the event of car gate gets opened when passengers are in the car, the elevator shall be brought to rest.

4.0 CAR

Cabin Size

The internal **clear** dimensions of the cabin shall not be less than those specified in IS 14665-Part I and as per CPWD specifications.

Car Display Panel

The Car Display panel shall be of LCD. This shall indicate the Car capacity, floor indication, direction of travel, current time and date at the minimum.

Frame and Safety Device

The car frame shall consist of steel channel top and bottom securely riveted or bolted and substantially reinforced and braced so as to relieve the car enclosure of all strains when the safety device comes into action due to over speed or when the capacity loaded car is run on the buffer springs at normal speed.

The safety device mounted on the bottom members of the frame operated by a centrifugal speed governor shall be arranged to bring the car to a gradual stop on the guide rails in the event of excessive descending speed; and provision shall be made to shut off the power supply to the motor.

Doors

Provision shall be made for vertical and horizontal fine adjustment of doors.

Door Operators

The door operators shall be VVVF inverter controlled heavy duty A.C. motor, allowing variable opening and closing speeds, and with full synchronization of car and landing doors.

Emergency Lighting

Emergency lighting with battery backup shall be provided.

Evacuation

An emergency key shall be provided on each landing to unlock the doors for evacuation and maintenance.

The doors shall be capable of being opened manually during power failure from inside the car when the car is within a landing zone.

Intercom

The intercom system in the lifts shall be capable of two way communication. Necessary arrangements shall be provided for communication between the lift cars, respective machine room, Fire Control Room, Reception and the room of the Facility Manager.

The main control for the EPBX/ Intercom shall be placed at Fire control room.

The intercom system shall be provided with a power backup of at least 30 minutes.

Manual Cranking Facility

Manual cranking facility shall be provided in the machine room to facilitate evacuation of passengers in case of power failure. The manual mode shall be in addition to automatic car failure operation specified elsewhere.

Emergency Stop Switch

A stop switch in the machine room / top of car shall be provided for use by maintenance crew to cancel all car and landing calls for a particular elevator.

Maintenance Switch

On operation of the maintenance switch located on top of the car by the maintenance crew, the car shall travel at slow speed not exceeding 0.85 m / sec by continuous operation of a button

Overload Indicator

An overload indicator with buzzer shall be provided in the cabin to indicate to the passengers that the car will not start as it is overloaded.

Operating Panels, Buttons & Switches

Car operating panels, buttons and switches shall be located on the front wall panel next to the car door and as specified.

All buttons and switches shall be clearly legible with fade-proof text and figures, and shall be easily accessible, especially for disabled persons in Elevator L-2.

Other Features

All features specified in the Schedule shall be provided.

5.0 PAINTING

All exposed metal work furnished in these specification, except as otherwise specified shall be given one shop coat of anti-corrosive primer after approved surface treatment of metal surfaces and two coats of approved enamel paint of approved shade.

6.0 TESTS AT SITE

The following tests, in addition to those mentioned in the CPWD specifications, shall be carried out to the satisfaction of the Engineer-In-Charge.

The car shall be loaded until the weight on the rope is twice the combined weight of the car and the specified load. The load must be carried on for about 30 minutes, without any sign of weakness, temporary set or permanent elongation of the suspension rope strands.

The following items shall be tested :

No load current and voltage readings both on 'Up' and 'Down' Circuits.

Full load current and voltage readings both on 'Up' and 'Down' Circuits.

One and quarter load current and voltage readings both on 'Up and 'Down' Circuits.

Stalling current and voltage and time taken to operate overload.

Overload protection.

Car and counterweight buffers with contract load and contract speed.

Manual operation of elevator at mid-way travel.

Emergency operation.

Tests on completion shall also be performed to the satisfaction of Inspector of Lifts.

7.0 STATUTORY APPROVALS

All statutory approvals from commencement to commissioning of elevators shall be obtained by the Contractor from the Inspector of Lifts, Chief Fire Officer and other authorities, if required. However the Department shall provide all necessary assistance for providing documents, drawings and certificates pertaining to other contractors, as may be required. The Department shall reimburse the statutory fees paid in connection with the approval of installation of elevators.

8.0 ADDITIONAL FEATURES REQUIRED

Fireman's Switch

A fireman's toggle switch shall be provided in a break glass for the specified elevator at ground floor to enable firemen to bring the elevator non-stop to ground floor from any location and to cancel hall calls until the car is operated on attendant control.

Anti - Nuisance

If number of calls registered is in excess of corresponding car load, all car calls shall be cancelled.

Home Landing Facility

A car shall return to a pre-determined landing after the last call is answered.

Load Non stop

When the car load exceeds a predetermined limit the elevator shall not respond to hall calls.

Separate door times

When a car responds only to hall calls or only to car calls, the door shall open for a shorter time than when responding to both car and hall calls.

Door Failure Operation

When an obstruction prevents a door from opening, the controller shall attempt its removal by repeated opening and closing, failing which the car shall travel to the next floor.

Nudging Door Operation

When the doors remain open for more than a predetermined period a buzzer shall sound and the door shall close automatically. The door sensing device shall be rendered inoperative but the Door Open button and the safety shoe shall remain operative.

Self - Diagnostic Facility

The Controller shall perform self - diagnostic tests and report the health of the system. The system shall take care of minor faults like door operation and motor overheating.

Car Failure Operation

In case of car mal-function, the system shall make a self - diagnostic check and then allow the car to travel to the nearest floor at slow speed, if safe.

Selective floor Service

Programming for selective floors services shall be software driven.

Auto Fan Off

In case no calls are registered for pre-set time, the cabin fan shall be automatically switched off.

Automatic Rescue Device

In case of mains power failure and elevator control system failure, the elevator's own rechargeable and maintenance free battery power shall move the car to the nearest floor and the door shall open automatically for automatic rescue of passengers. A battery run-down indicator shall be provided.

Automatic Rescue Device shall be provided for all the Elevators.

9.0 PERFORMANCE PARAMETERS

The following parameters shall be achieved in the installation:

Leveling Accuracy : + 3 mm

All other parameters as per CPWD Specifications and IS shall be achieved.

Refer Lift Schedule.

LIFT SCHEDULE

S.No.	DESCRIPTION OF LIFT	UNITS	SHAFT SIZE	CAPACITY	HEIGHT	STOPS
A.	HOSPITAL BLOCK					
TOWER 1	ATTENDENTS LIFT	2	1800 X 3000	15 / 16 PAX	G+6	7
	SERVICE LIFT	1	2150 X 3000	1000 KG	G+6	7
	PATIENT LIFT IN FUTURE (HELIPAD) 1 no		2400 X 3000		G+7	8
TOWER 2	PATIENT LIFT	6	2150 X 3000	15 / 16 PAX	G+6	7
	PATIENT LIFT	1	2400 X 3000		G+6	7
	SERVICE LIFT	1	2150 X 3000	1000 KG	G+6	7
TOWER 3	STAFF LIFT	2	2150 X 3000	15 / 16 PAX	G+6	7
	PATIENT LIFT	1	2150 X 3000	15 / 16 PAX	G+3	4
	LIFT IN FUTURE (STAFF) 1 no		2150 X 3000	15 / 16 PAX	G+6	7
	TOTAL	14				
B.	R&D and ACADEMIC BLOCK					
1.	PASSENGER LIFT	1	2150 X 3000	15 / 16 PAX	G+4	5
2.	PASSENGER LIFT (Future) 3 nos		2150 X 3000	15 / 16 PAX	G+4	5
3.	PASSENGER LIFT (Staff Side)	2	2150 X 2400	8 TO 10 PAX	G+4	5
	TOTAL	3				
C.	2BHK FACULTY TOWER					
1.	PASSENGER LIFT	1	2150 X 2950	15 PAX	G+6	7
2.	PASSENGER LIFT	1	1900 X 2150	8 TO 10 PAX	G+6	7
3.	PASSENGER LIFT- (Future) 1 no		1900 X 2150	8 TO 10 PAX	G+6	7
	TOTAL	2				
D.	3BHK FACULTY TOWER					
1.	PASSENGER LIFT	1	2150 X 2950	15 PAX	G+6	7
2.	PASSENGER LIFT	1	1900 X 2150	8 TO 10 PAX	G+6	7
	TOTAL	2				
E.	GUEST HOUSE + RESIDENT HOSTEL					
1.	PASSENGER LIFT	1	2150 X 2950	15 PAX	G+6	7
2.	PASSENGER LIFT	1	1900 X 2150	8 TO 10 PAX	G+6	7
3.	PASSENGER LIFT- (Future) 1 no		1900 X 2150	8 TO 10 PAX	G+6	7
	TOTAL	2				
F.	NURSE HOSTEL					
1.	PASSENGER LIFT	1	2150 X 2950	15 PAX	G+6	7
2.	PASSENGER LIFT	1	1900 X 2150	8 TO 10 PAX	G+6	7
	TOTAL	2				

16. EMERGENCY LIGHTING

Self-Contained Emergency light (LED)

In Residential building/ Hostel, the self-contained emergency LED light (6-8W, indoor type) is used and should be as per GFC drawing. Suitable for operating temperature 0-50 degree centigrade, the input supply voltage is 220-240V AC, 50/60Hz, protection class is IP:20, power factor ≥ 0.9 , THD@240V Battery type 3.6V Ni Cd, Battery charging time 4-6hr, battery discharge time/ Backup time 3 hr, light efficiency is 110 lumen/watt.

17. INTELLIGENT ADDRESSABLE FIRE ALARM SYSTEM WITH INTEGRATED VOICE EVACUATION SYSTEM (INDEPENDENT EVACUATION SYSTEM FOR HOSPITAL SHALL BE PROVIDED)

B. Basic Performance:

3. Notification Appliance Circuits (NAC) shall be wired NFPA Class A, Style X as part of an addressable device connected by the SLC Circuit.

1.1 DESIGN INTENT

- a. All fire alarm panels connected as pier to pier.
 - b. Fire survival cable mineral insulated copper conductor, LPCB approved, 950 degree centigrade 3 hours confirming to BS 6387 CWZ on continuous testing of same cable, shall be used in Fire Alarm and Evacuation system.)
- c. Class - A, Style X cabling to loop all detectors, devices & MCP"s to control panel.
- d. Coverage per detector as per NFPA -2015, considering > 60 ACH

C. Underwriters Laboratories Inc. (NFPA-72/EN-54 standard) - USA:

2.1 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

System Capacity and General Operation

- A. The FACP shall can communicate on a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mbps and support up to 32 panels / nodes per network.
- B. The control panel shall be capable of expansion via up to 8/10 SLC loops. Each loop shall support minimum 120 analog/addressable devices for a system capacity of minimum 960 points. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 200-character liquid crystal display, individual, color-coded system status LEDs, and keypad (as per manufacturer) for the control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either company.
- C. All programming or editing of the existing program in the system shall be achieved without interrupting the alarm monitoring functions of the fire alarm control panel.
 17. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.
 18. Local Mode: The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU. CPU, Network, Loop card, display and power supply the system shall be 100% hot redundant and instantly switch to redundant CPU, Network, Loop card, display & Power supply.
 19. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.
 24. Mass Notification Override: The system shall be UL/EN 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.
 25. Security Monitor Points: The system shall provide means to monitor any point as a type security.
 32. Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year

with ability to set and restore based on a 24 hour time schedule on any day of the week or year.

6. The RS-232 serial output circuit shall be optically isolated to assure protection from earth ground.
7. To maintain the foolproof redundancy at critical facilities for zero down time suggested that Panel shall support hot redundancy at CPU, Network, Loop, display and power supply level .

F. Display

1. The system display shall provide a 200-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.
2. These characters shall be only for fire alarm / trouble information and not for Logo or other purpose. It shall be UL/EN Listed. Repeater panel displays in FACP is not allowed unless until approved by UL/EN
3. The system display shall provide a QWERTY/ALPHANUMERIC keypad for ease of operation.
4. The keypad shall have control capability to command all system functions, entry of any alphabetic or numeric information, and field programming without the use of any external equipment or laptop. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

G. Loop (Signaling Line Circuit) Control Module:

1. The control panel shall be capable of expansion via up to 8/10 SLC loops. Each loop shall support minimum 120 analog/addressable devices for a system capacity of 3000 points. Adding more devices in one loop is not a reliable solution, in case of single loop card failure, more area will be affected.
2. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any conventional device input shall be capable of activating any or all conventional device outputs) in the unlikely event of a failure in the main CPU. To maintain the foolproof redundancy at critical facilities for zero down time suggested that Panel shall support hot redundancy at CPU, Network, Loop, display and power supply level.
3. Each loop shall maintain 20% spare capacity for future expansion.
4. Each Loop shall be capable of operating as a NFPA Class A, style X wiring circuit in case of single open circuit fault in existing SLC Circuit.
5. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

H. Network Communication

The FACP shall communicate over a peer-to-peer communication network, inherently over a regenerative communication format and protocol. The network shall support communication speed up to 100 Mbps and support up to 32 Control Panels / Network Nodes, over a single medium (copper conductor / fiber optic), redundant ring, communication channel for fire alarm, voice evacuation and telephone talk-back system. The system shall support up to 32 such networks in a single system.

The network card shall have inbuilt Fiber port for terminating Fiber Optic Cable without any third party converters.

- h. Support an optional mode of operation with four analog audio outputs capable of being used with UL/EN 864 fire-listed analog audio amplifiers and SLC controlled switching.
- k. The Voice Evacuation System shall be capable of establishing communication between the

master voice controller and amplifier over fiber optic cable network without using any third party media converter.

- I. Deleted.
4. The Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Main Power Supply shall be power-limited per UL/EN 54 requirements.
6. The Main Power Supply shall communicate power supply, line voltage, battery status and charger status to the local LCD display. Any abnormal condition shall be annunciated and logged to the system alarm history log.

I. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL/EN-54 window and have a minimum of 5 levels.

The NCA shall include a 10" (1024 x 600) Color touchscreen display/LCD with QWERTY/ALPHANUMERIC Keypad. Additionally, the network display shall include environmental adjustment controls to maximize LCD legibility and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc. (The NCA shall be active networkable and shall have provision of uploading Graphics zone wise detail for quick review.)

The NCA shall have facilities to download log event, history. The Port shall be as per OEM. The FACP shall have inbuilt printer.

The NCS shall be fire UL/EN complied.

The NCS shall include an industry-standard RS-232 port for a UL/EN-54 listed printer.

8. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL/EN-54 as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
9. The detectors shall be ceiling-mount directly connected on the addressable loop and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support Addressable Loop powered/ externally powered intelligent programmable sounder, without any additional power supply. The programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.

J. Intelligent Multi Criteria Detector

Multi criterion detectors shall be used, except for kitchen, Pantry and Laundry

The detector shall be UL latest edition/ EN approved with a facility of auto addressing, white in color, Two-wire SLC connection, led for providing healthy or fault indication, remote test facility & inbuilt/ external fault isolator. The detector placement shall be designed as per NFPA 72/EN-54.

K. Advanced Multi-Criteria Intelligent Fire/CO Detector

1. Advanced Multi-Criteria Fire/CO detector be an addressable advanced multi-criteria smoke detector with a separate signal for carbon monoxide (CO) detection per UL/EN-54.

L. Advance Speaker Strobes

1. The Speaker Strobe appliance shall be listed to UL/EN standard and be approved for fire

protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.

- D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed neither less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.1 TESTING**Integrated Fire Alarm, Voice Evacuation & Telephone Talkback System**

S. No	Description	R&D and Academic Block	Hospital Block	Guest House	Nurse Hostel	Housing
E	Notification Devices					
1	Addressable Sounder cum Strobe rated at 80 dBA @ 3m for Audible annunciation and 115cd flashing at 1 Hz for visual indication. UL Listed	R	R	R	R	R
3	Both 2W & 6W, Ceiling Mount Speakers . The speakers shall be of same make as that of the Control Panel & Amplifiers. They shall be compatible with supplied Amplifiers and shall work on 70.7Vrms. UL Listed	R	R			
4	Both 2W & 6W, Wall Mount Speakers . The speakers shall be of same make as that of the Control Panel & Amplifiers. They shall be compatible with supplied Amplifiers and shall work on 70.7Vrms. UL Listed	R	R	R	R	R
2	Fire Fighter's Telephone Handset for two way communication between Remote Fire Fighter & Fire Command Center	R	R	R	R	R
	Note: Volume controller for speakers specification shall be also be provided to control volume level in areas as required by IIT team					
G	Cables					
1	2 x 1.5 sq mm mineral insulated copper conductor Fire survival armoured cable, LPCB approved, 950 degree centigrade 3 hours confirming to BS 6387 CWZ on continuous testing of same cable, shall be used .	R	R	R	R	R

Integrated Fire Alarm, Voice Evacuation & Telephone Talkback System

S.No.	Description	Unit
1	<u>INTELLIGENT ANALOGUE ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM CONTROL PANELS, MODULES, SENSORS & ALARM INITIATING DEVICES</u>	
1	Supply, installation, testing and commissioning of following as per specifications:	
1.1	UL Listed Microprocessor based intelligent and modular, 100% electronically addressable system where field device addressing is done by panel and not user, complete touch screen system with peer to peer networking of 126 network nodes, loop capacity of 120 devices per loop, built in charger that can support backup upto 24hours idle condition and 30 minutes during alarm condition, integral thermal printer, option to interface to BMS with optional interface of LON Works, BACnet & Modbus, optional Graphics interface, optional Webserver, 96 Zonal LEDs on board, capacity to have upto 250 logic zones created, LCD screen of LED technology, 4 NAC circuits, 3 programmable relays, dedicated Alarm relay, Integral short circuit, Event history on 9999 logs, option to load Logo on the main screen, view live analog level of field devices on the panel screen, option to download these events log and analog level report from panel, have open path programming software, capacity to communicate loop mount repeater panels, optional NAC power supply units that are loop mountable and 100% supervised from main panel, The no of loops for the FACP/ network of FACP shall be as per manufacturers panel specifications. The FACP/network of FACP shall be able to accommodate the given no of devices as per boq and shall have 10% spare capacity to accommodate future inclusions.	Nos
1.2	UL Listed Intelligent addressable Loop/ Network repeater panel with function keys like Reset, Alarm Acknowledge, Alarm Silence, Trouble Acknowledge on panel itself, 2 x 40 Backlit LCD display, 6 Supervisory LED's, Loop and network connected with battery back-up of 24 hours stand-by & 30 minutes alarming etc.	Nos
1.3	UL Listed Intelligent addressable touch-screen active repeater panel with function keys like Reset, Alarm Acknowledge, Alarm Silence, Trouble Acknowledge on panel itself, Programmable as an active or passive repeater, network capability up to 126 panels with battery back-up of 24 hours stand-by & 30 minutes alarming etc.	Nos
1.4	UL Listed Network Card for all addressable panel	Nos
1.5	UL Listed Addressable 2 wire optical smoke detector with built-in short circuit isolator, 100% soft addressing, single LED that covers 360Deg lightpipe technology with intensity that can handle upto 5000 Lux, Discreet design for incorporation into any décor, Common mounting base, Drift compensation, Removable detector chamber, detector sensitivity of 2.55+/- 0.33%/ft, Chamber monitoring by panel, option to connect remote indicator The detector shall be with inbuilt isolator complying to Style 7 wiring .	Nos
1.6	UL Listed Addressable 2 wire opto-thermal Multisensor (smoke cum heat) detector with built-in short circuit isolator, 100% soft addressing, single LED that covers 360Deg lightpipe technology with intensity that can handle upto 5000 Lux, Discreet design for incorporation into any décor, Common mounting base, Drift compensation, Removable detector chamber, detector sensitivity of 2.55+/- 0.33%/ft, Chamber monitoring by panel, option to connect remote indicator The detector shall be with inbuilt isolator complying to Style 7 wiring .	Nos

S.No.	Description	Unit
1.7	UL Listed Addressable 2 wire Multimode Thermal detector with built-in short circuit isolator, 3 operating temperature of detector selectable from panel, 100% soft addressing, single LED that covers 360Deg lightpipe technology with intensity that can handle upto 5000 Lux, Discreet design for incorporation into any décor, Common mounting base, Drift compensation, Removable detector chamber, Chamber monitoring by panel, option to connect remote indicator. The detector shall be with inbuilt isolator complying to Style 7 wiring.	Nos
1.8	UL Listed 2 Wire common mounting base that support all types of above detectors, Integral sensor shorting link, Separate loop in and loop out terminals, Dedicated earth terminal, Standoff fixing feature, Accepts side entry cables, Selectable sensor locking feature, Positive "lock" indication	Nos
1.9	UL listed 2 wired base sounder with built in short circuit isolator, option to choose 3 different volumes & 3 different tones from panel, mounting slot built in to mount any type of addressable UL Listed detector & provision to terminate shield wires on the base terminal	Nos
1.1	UL Listed Reflective type Beam detector , coverage upto 100M length, monitored for fault, fire and sensitivity/threshold level can be selectable. Combined transmitter and receiver unit in one discrete unit. Ingress protection should not below IP50. LED indicators for alignment process.	Nos
1.11	Duct detector unit with clear view top cover to visually identify the smoke/duct inside the duct detector & view the operation of Detector (LED Blinking), suitable for ducts from 300mm to 1500mm & wind flow speed of 1m/s to 20m/s, with sampling Inlet & Outlet pipes.	Nos
1.12	UL Listed Addressable 2 wire Pull Station with built in short circuit isolator, 100% soft addressed from panel, Wall mounting, resettable key option, Corrosion resistant gold plated SPST contacts, High-gloss red enamel finish with raised white lettering, option of Single action or Dual action, optional Whether proof back box	Nos
1.13	Supply of UL listed Wall mount or ceiling mount Horn with snap lock type, with maximum out of 99dB @ 1mtr with maximum current consumption of 0.064 A current with 24VDC or 0.047 A current with 12VDC.	Nos
1.14	UL Listed Horn Strobe that has capacity of multi selectable options 185CD with maximum current consumption of 185mA, Voltage test points for quick troubleshooting and easy spot checking, Contact cover provides protection from dirt, dust, paint and accidental damage, it also allows for pre-wire testing and troubleshooting	Nos
1.15	UL Listed Addressable 2 Wire Control module, 100% soft addressed, integral short circuit isolators, SPDT relay contact to drive sounders load upto 1Amps at 30VDC temperature, Non latching changeover relay contacts, optional module for output control. for, speakers, strobes etc. The devices shall be with inbuilt isolator complying to Style 7 wiring .	Nos
1.16	UL Listed Addressable 2 Wire Relay module, 100% soft addressed, integral short circuit isolators, SPDT relay contact to drive sounders load upto 1Amps at 30VDC temperature, Non latching changeover relay contacts, optional module for output control. for shutting down AHU's, and magnetic fire door holders. Elevator recall, fire damper, pressurization fan, etc. The devices shall be with inbuilt isolator complying to Style 7 wiring.	Nos
1.17	UL Listed Addressable 2 Wire monitor module, 100% soft addressed from panel, integral short circuit isolators, capable of monitoring NO contacts, Option to choose operation mode as supervision of 20Sec or activation immediate to connect NO/NC contacts such as pressure switch, flow switches, fire pump contacts etc. The devices shall be with inbuilt isolator complying with Style 7 wiring.	Nos
1.18	UL Listed Remote Indicator High visibility LED, Wide viewing angle for increased visibility, Discreet design for incorporation in to any décor.	Nos

S.No.	Description	Unit
1.19	Supervised remote power supply/battery charger in a low profile cabinet that is used for supervision and expanded power driving capability of fire alarm Notification Appliance Circuits (NAC). is filtered and regulated and provides 8 amps of power distributed across 4 outputs. The power supplies may be connected to any 12V or 24V (FWR or DC) Fire Alarm Control Panel (FACP) by using a NAC or a "Dry Contact." Primary applications include NAC expansion (supports ADA requirements) and auxiliary power to support system accessories. This unit provides filtered and regulated 24VDC, up to four (4) Class "B", two (2) Class "A", or two (2) Class "B" and one (1) Class "A" Notification Appliance Circuits. . Additionally, an auxiliary power output of 2.5 Amps (disconnected upon AC power loss or an alarm condition) or up to 0.240 A of constant power on the .Approved with UL Standard 864, UL 1481.	Nos
1.20	Supply, installation, testing and commissioning of Graphical Software with Remote and multiple user access, 2D and 3D viewing mode to control and interrogate fire systems. Capable to connect 50 Networks & 250 Zones per Network. Events capacity should be 99,999,999. Multi network supervision over TCP/IP. Design Support 10000 Buildings, 30000 Floors/Graphics Screens, 100000 Panel/Device Icons/Symbols. Supports floor plan formats like BMP, PNG, JPG, TIFF, GIF, PDF	Nos
1.21	Addressable Panel/Interface Programmer	Nos.
2	Fire Fighter Telephone System	
2.1	Supply, Installation, testing and commissioning of Fire Fighter Telephone System , Five zone master unit, surface or semi-flush mounted, 5 line keys, 1 fault accept, 17 status LEDs, fully duplex, monitor Type A and Type B outstations & emergency assist alarms, panel with built in battery & battery charger, two 30V DC 1A rated volt free relay	Nos.
2.2	Supply, Installation, testing and commissioning of Roaming handset , Automatic "off hook" dialling, Constructed of Acrylonitrile butadiene styrene UL90V1, Red in Color	Nos.
2.3	Supply, Installation, testing and commissioning of Jack plate , Full duplex operation, surface or flush mounted, Constructed of Brushed stainless steel, Monitor dc open, short and earth	Nos.
3	Evacuation System	
3.1	Supply, installation, testing and commissioning of 6W Multi-Tap (1.5W; 3W; 6W), Ceiling Mount Speakers.	Nos.
3.2	Supply, installation, testing and commissioning of 6W Multi-Tap (1.5W; 3W; 6W), Wall Mount Speakers.	Nos.
3.3	Supply, Installation, Testing & Commissioning of 500W, Class -D Amplifier, 70/100V with rated power 500W.	Nos.
3.4	Supply, Installation, Testing & Commissioning of 6 Zone PA Controller. It should have functions like the audio playing, zone control, volume control etc.	Nos.
3.5	Supply, Installation, Testing & Commissioning of Voice command keypad 6 zone, with microphone assembly complete as required.	Nos.
4	<u>CABLES</u>	

S.No.	Description	Unit
4.1	<p>Fire Survival Cable: For the detector and sounders proposed to fixed on false ceiling/surface, the wiring shall be done with Fire Survival Cable capable of withstanding temperature up to 950 C for 20 minutes and 650 C for the 180 minutes. The fire survival cable shall be laid on surface with proper saddle etc. ar per requirement & in cable tray above false ceiling. The cables may be armoured/unarmoured as per the location of use.</p> <p>Wire: Fire alarm system wiring to be carried out with 1.5 mm² PVC insulated copper conductor cable for detectors and sounders and the conduit for the same have to be embedded in the ceiling.</p> <p>Wiring shall be in accordance with CPWD specification (Electrical) -2013. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 1.5 sq.mm. for initiating device circuits and signaling line circuits for notification appliance circuits.</p> <p>Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).</p> <p>Wiring used for the signaling line circuit (SLC) shall be twisted and shielded and installed in conduit unless specifically accepted by the fire alarm equipment manufacturer.</p> <p>All field wiring shall be completely supervised.</p>	Mtr.
4.2	Supplying and Laying of 2 C X 1.5 Sq mm multi stranded twisted shielded FRLS Copper Speaker cable.	Mtr.

18. IP-PBX SYSTEM

S.No.	Technical Specification	Complied (Yes/No)
1	General requirement of server (Server-gateway architecture) based IP EPABX system with necessary software, hardware and license	
2	The objective of this work is to install the main exchange system of min 300 Users, by an IP based communication/Intercom server. The communication servers to be installed at respective locations & will function in active-active mode. All the servers shall be connected via LAN Network.	
3	The tenderer must submit valid TEC certificate as per TEC/GR/SW/PBX-005/01/SEP-16 or latest with Type I, Type-II, Type III -Types of Interface for the particular model of system Quoted and the same must be issued in the name of Manufacturer/ any dealer of OEM / Bidder. Letter of authorization for this tender must be enclosed with tender document.	
4	a) Server & Media Gateway based system which must be tested for IPv4 & IPv6 with SIP terminals and SIP Trunks both from day1 issued by concerned authority, as mandated by the Ministry of Telecommunication.	
5	b) Conformity to Dry Heat for 16 hours at maximum specified temperature degree C in accordance with IS:9000/part-2	
6	c) Conformity to Cold Test for 4 hours at minimum specified temperature degree C in accordance with IS:9000/part-2	
7	d) Conformity to Damp Heat (Cyclic)Test for 2 Cycles of 24 h each at a temperature of 40 degree C & 95% RH in accordance with IS:9000/ part-5	
8	The system should be mounted on 19" rack	
9	Intercom numbering should be flexible.	
10	Documentary proof /certification from OEM are mandatory for authorization, license and software for this tender.	
11	Tenderer shall submit complete design solution detailing complete quantification of equipment, hardware, software, application etc. (In case of non-submission, tenderer shall be liable for rejection from this tender)	
12	System should have facility of PRI interface, ACD NMS & audio conference with necessary license & software.	
13	System should be compatible for IP phone and video IP phone.	
14	Video IP Phone with Power Adaptor.	
15	Tenderer shall submit authorization from OEM to confirm the service & spares availability for at least 12 years of the offered solution after completion of warranty.	
16	SIP Endpoints: System should support Mobile clients, Softphone clients, IP/SIP phones connected with server- gateway communication intercom users should act as same extension/parallel ringing clients.	
17	Bidder should have the work experience with the same OEM products for at least 5 years.	
18	IP Telephony system architecture:	
19	The IP telephony system should be based on an IP technology (IP at core) server and gateway type software solution based communication system. PCM-TDM based telephone system (card based processor) shall not be accepted. The system should be ipv6 ready from day one. It should be possible to install the Telephony system in VMs (Virtual Machine) and cloud also.	
20	System should support Active-standby redundancy.	

S.No.	Technical Specification	Complied (Yes/No)
21	The Offered system should support Enhanced Unified Communication features like call forward, Call back, Missed call details, Phone book, Click to call, Text , VM, File Sharing through their personal desktop or laptop over web based portal.	
22	Offered solution must be based on IMS architecture with HSS, CSCF, MRF, SGW. It must support installation on both physical as well as virtual server.	
23	There must be facility to distribute or install any one of the IMS Module into different server for load sharing in future if required. Demonstration for the same to be provided by the tenderer before final commissioning of the system.	
24	Bidder may asked for the demonstration of the system, if required during Technical evaluation stage before placement of the order. Demonstration to be shown within 2 weeks from the date of intimation by the customer.	
25	Solution must support all applications such as Call Control, UCS, NMS, Database, LDAP, Billing, SBC, Load Balancer in single server. No separate server for any application.	
26	Server in HA mode can work on single port , no other port will be required for database synchronization.	
27	The 1+1 communication server redundancy will function in active stanby mode. In-progress PSTN calls at each of the location should not be interrupted in the event of call server failiure/switchover or WAN link failure.	
28	The 1+1 communication server redundancy will function in active stanby mode. In-progress PSTN calls at each of the location should not be interrupted in the event of call server failiure/switchover or WAN link failure.	
29	The system should be based on Server – gateway (Client) architecture. The Server should be built on Industry standard Server.	
30	IP server should be commercially of the shelf (COTS) and should not be a proprietary, must be 19” rack mountable like Hp/Dell/IBM/Lenovo or any reputed brand in N+1 redundancy mode and should have following specification:-	
31	Server Specs -Each Server must have: Intel Xeon Processor Min 8 GB RAM RDIMM- 1TB Hard Disk 1Gig Dual Ethernet Ports Power Supply Input : 220V AC 50Hz	
32	The IP telephony system must support unified communication (UC) server & gateways architecture for SIP, Digital and Analog trunks /subscribers connectivity. Required necessary accessories for connecting multiple gateway to the server should be provided by tenderer at his own cost for operation of server- gateway communication system.	
33	All telephony servers must form a single cluster and should have common database so that any gateway can be registered to any server without any problem in case of network / server failure. Replication of database should be in real time between servers.	
34	The solution should allow the servers and gateways to be placed at geographically separated locations on requirement. System must support same or different subnet in HA mode for all location	
35	The system should be able to use SIP endpoints as extensions for the users and IP trunks should be able to interconnect with existing EPABX installed at different station. SIP trunk should provide feature like caller id, name, camp-on/call back, call forward etc.	
36	The IP telephony system shall support all standard SIP enabled third party IP Phone, OEM-IP/SIP Phone (end points), OEM-Mobile Clients (end points), OEM web-based clients on PC (end points) etc.	

S.No.	Technical Specification	Complied (Yes/No)
37	Any third-party SIP enabled phones should work with this solution having SIP/IP third party license. Basic call functionalities shall be supported on any third-party SIP enabled IP Phones.	
38	OEM IP/SIP Phones shall have complete feature transparency and support SIP end point for OEM mobile client and soft phone clients.	
39	Total system should operate on 220V AC or 48V DC both power source. Conversion from AC to DC or DC to AC will be in bidder scope.	
40	The system should support PC telephony for all users.	
41	Analog extension – user of Analog extension should be able to view the details of missed calls on the computer interface application. All (Analog, Digital & IP) user should be able to view the call log on the computer and dial the numbers (Both Audio & Video Calling) from computer. User should be able to create own personal directory on its computer. User can search the name / number form the directory and dial the desired number directly from computer. All users must have facility like call forward, Call back, Missed call details, Phone book, Click to call, Text, VM, File Sharing through their personal desktop or laptop.	
42	IP User – IP user should be able to view the call log on the computer and dial the numbers from computer. User should be able to create own personal directory on its computer. User can search the name/ number form the directory and dial the desired number directly from computer.	
43	The complete system should be compatible to tropical climate prevalent in India i.e. ambient temperature range +5 to +40 degrees Celsius and relative humidity of about 20% - 80%.	
44	The IP-PBX system shall be scalable at least up to 15000 devices to achieve future growth requirements without any additional server or cluster server.	
45	The system should be capable of supporting trunks / subscribers of IP, Analog, Digital, RIC, GSM, E&M and SIP from day one. All necessary hardware/software should be provisioned from day one.	
46	The gateway shall be non-blockable i.e. all IP Phones should be able to call all type users at any point or vice versa. For this provision tenderer must enclose documentary proof with the tender document.	
47	System shall support Digital phones at least 1 km on 0.5 mm cu cable from the main exchange/ gateway. System should also support all types of end points i.e. third party IP phones with SIP standards, OEM-Digital multi key telephone, third party Analog Phone, OEM-Mobile Clients, OEM-Soft phones / clients, OEM – IP Phones and Video IP Phones etc.	
48	System administration should be possible through web browsers. All server and Gateway can be accessible from any of the locations.	
49	The system shall have Caller Line Identification for all network subscribers including all analog, digital, IP subscribers and trunks. Tenderer has to provide necessary hardware / software to present caller-id for all users in complete system from day one. In addition to this the Caller ID, Camp on, name transfer should also be available to existing EPABX and vice versa.	
50	System shall work with existing exchange and integration of the existing system shall be done on IP at the time of installation and commissioning by the bidder free of cost	
51	Reliability	
52	The inability to perform any required function, the occurrence of unexpected action or the degradation of performance below the specifications shall be considered as a failure.	
53	MTBF shall be the average operating time accumulated by the total population of identical items between failures.	

S.No.	Technical Specification	Complied (Yes/No)
54	The system should be capable of supporting a high traffic and should support minimum busy hour call completion (BHCC) 2,50,000 and above.	
55	Connection Time	
56	The time taken to connect one extension line to any other extension line (to application of ring tone) within the network shall conform to latest ITU-T recommendation.	
57	Power failure transfer circuits The connection time of any fall-back lines on failure of the main switching equipment shall not be greater than 5seconds.	
58	Alarms Alarms shall be received and implemented by the Network Management System with delay no longer than 5sec.	
59	Remote Monitoring Remote scanning of system conditions, alarms and traffic data shall not take longer than 3 seconds for the total network.	
60	Psophometric Noise	
61	The Psophometric Noise Voltage of any other telephone line shall not exceed 2 mV.	
62	NETWORK MANAGEMENT SYSTEM	
63	a) The bidder must provide required hardware and Centralized GUI based software for configuration, management and monitoring of the PBX system and remote gateways. It shall be possible to carry out maintenance and administration of the entire network (Servers and gateways) from a central location. Monitoring system shall provide a continuous real-time indication of the system status. All hardware and software required for this function except desktop computer is in the scope of bidder. The System should have provision of instant fault information	
64	b) The system shall allow multiple logins from multiple locations. The system shall maintain a history log of last command along with log in name & commands given. c) The system management should enable users to navigate, display, add, modify and /or remove the system and related switch components in a user friendly manner.	
65	d)The system offered should assist in the creation of station and IP subscriber details by automatically providing help such as available extensions and ports and allowing users to base the creation on an existing template.	
66	e) Hardware Manager: Should allow users to graphically display cabinet information, Card status, current alarm status, and assigned cards to a slot.	
67	Network Management System - The Telephone Subsystem shall incorporate on-line automatic, self-diagnostic maintenance facilities that enable fault management, configuration and performance management. All equipment shall be monitored to ensure that a failure at card level can be detected and be reported to the internal fault diagnostics system. A database shall be built for defining the system configurations. Any change in the database shall automatically be updated on to suitable storage devices such that an up to date version of the configuration is available in case there is a system or power failure. The Network Management System shall have GUI functionality, auto discovery features and will be able to monitor and provide overall control and supervise EPABXs as well as the switch to carry out the following system administrative and monitoring functions:	
68	Call Management;	
69	Fault Monitoring;	
70	Performance Management	
71	Traffic Monitoring.	
72	Graphical view of the Telephone network	
73	Record and History Management.	

S.No.	Technical Specification	Complied (Yes/No)
74	To monitor all IP based endpoints (SIP phones, server, Gateways, switches) devices in LAN, an android based free app should be developed/supplied along with server. This app should have features like status, response time, last change status and logs of devices.	
75	Should monitor different devices through mobile App	
76	Should have dashboard, which gives you a bird's eye view of your network's performance	
77	Should Provide real-time views of availability statistics.	
78	Should Analyze bandwidth consumption across your network with Traffic Summary of Devices & Interfaces	
79	Should Sends alerts for performance and availability issues. Should receive alerts through notification	
80	The Telephone Subsystem shall have provision of at least three month call details record in case of Network management system fails. GUI functionality of the NMS shall be provided with proper hierarchy to enable proper monitoring and operation of all elements of the voice network at all office.	
81	Fault and Alarm Management	
82	The network management system shall be equipped with a, self-diagnostic, fault and alarm management of all elements of the operational Telephone Network and associated interfaces.	
83	All relevant information shall be accessible to the operator from the Management Workstations.	
84	It should also provide advanced Endpoint Diagnostics in a robust platform designed to further support troubleshooting efforts. It should benefits of SIP phone remote control, bulk calls, event monitoring, and screen and packet capture	
85	The fault management system shall, on a real-time basis, monitor and display the fault, event and alarm status in addition to the acknowledgement and resetting of alarms.	
86	The system shall store alarms in the database for future analyses.	
87	All incidents together with equipment and software failure shall be recorded, time and date stamped with an immediate alert provided to the Workstation operator.	
88	The Management Workstations shall provide a centralized and integrated colour display of all the Operational Telephone Subsystem alarms and events.	
89	NMS with following features	
90	The system must include a dedicated management server/platform. The management platform must provide a single graphical client (Graphical User	
91	Interface (GUI)) as well as a web based interface for all network elements used in the IP PBX network. The management platform should support the following tasks :-	
92	1. Provide centralized management in local or remote environments of a single system or a network.	
93	2. NMS can create automated topology on a geographic map for quick overview of the deployed network	
94	3. This module must be able to centralize the alarms and events of the System and give colors according to the severity level of the alarm.	
95	4. Register and generate statistics for the alarms and events in the network on a daily basis.	
96	Notify an alarm depending on the severity level.	
97	System Management:	
98	Should provide a dedicated management platform from that will be based on the latest technologies. This server should support a minimum of five or more clients having different access rights to the applications.	

S.No.	Technical Specification	Complied (Yes/No)
99	GUI based Centralized management should be available for the telephony system including all the modules/server in cluster. All gateways shall be centrally managed by this GUI management. System administration should be possible through web browser.	
100	The Management platform should provide web access allowing the administrator to manage the system to use any PC with an internet browser.	
101	Management platform: - should be able to configuration and programming, fault and alarm management fault diagnosis and support the malicious call trace. The management platform must allow the administrator to generate reports and graphics of the activity per period of time in terms of traffic, accounting and alarm.	
102	System Features:	
103	It shall Support following min. Trunk Feature:	
104	Support all signaling standards	
105	CO/Tie line restriction	
106	CLI	
107	Support for R2MFC	
108	Trunk to trunk transfer	
109	Q-Sig Compatibility with all features	
110	Area code restriction	
111	SIP	
112	Protocols:	
113	The exchanges shall support Caller Line Identification for all ISDN & IP network subscribers including analog subscribers.	
114	Exchange shall support following signalling Protocols- (i). ISDN PRI, CEPT, (ii). ISDN BRI, (iii). E&M (2/4 Wire), (iv). DTMF, (v). All the Common Signalling Standards adopted for ISDN / Non ISDN connections to PSTN, (vi) E1- CAS (vii) SIP Trunk (viii).GSM	
115	Exchange should support Automatic Call Distribution (ACD) functionality.	
116	Exchange should support upgradeable to CTI with direct Ethernet Connectivity.	
117	General:	
118	Numbering Scheme: The system should be suitable for up to minimum 8-digit extension numbering scheme. This numbering scheme should be flexible. System should also allow mixed numbering scheme.	
119	There should be minimum six type of ring cedence (Alarm, VIP, Intercom, Trunk, Call Forward, Call back)	
120	Basic Telephone Features as mentioned in other sheet: Telephone Feature	
121	Abbreviated dialling, reminder, Automatic call-back on busy trunk/network link, Automatic DISA, user authentication, call forwarding unconditional on busy/no reply to extension, hunting group, Voice mail, operator, paging etc.	
122	Call Back, Call forward, Call Park, Caller party, extension number display, Call pick-up, Call transfer, Call waiting, Conference call, Direct inward Dialing, Direct outward Dialing, Distinctive ringing, Hot line, Hunting, Abbreviated Dialing, Access to Paging, Executive Override, Attendant Recall, Alternate Route Selection, Forced Release, Line lock out, Malicious call trace, Music on hold, Recorded Announcement	
123	Immediate forwarding Call pick-up. Call parking, Call waiting indication/ voice prompt.	
124	Calling line identification restriction for internal calls Camp on busy telephone/hunting group/voice mail, Controlled private call by Pin code and password.	
125	Do not disturb, Dynamic call baring, General night service & Hunting group	
126	Internal/external music on hold internal/external inquiry call individual hold instrument locking to prevent the outgoing.	

S.No.	Technical Specification	Complied (Yes/No)
127	Last internal/external number redial, Store and redial external number, Transfer in conversation on free/busy telephone.	
128	CLI coming in from ISDN PRI trunks should be displayed on Analog Telephones, Digital Telephones and IP Telephones.	
129	Gateways	
130	The gateways shall be capable of being centrally managed via the telephony management application/server. The system should support multiple gateways. System gateways should support the Analog, Digital, RIC, E&M, GSM, FXO, PRI extensions.	
131	All gateways should be 19" rack mountable from same OEM (IP PBX manufacturer with TEC GR certificate along with make and model) on whose authorization bidder is quoting. Gateways should have distributed architecture i.e. if needed gateway can be kept on different locations as and when required. (documentary proof from OEM is mandatory for certification of gateways)	
132	The system gateway should be able to restart automatically without human intervention when the power supply is resumed after complete power failure.	
133	Gateway should have the provision of self-survival. If the server goes faulty, the gateway should work independently. Any Hardware/ software to make this functional to be provided by the bidder free of cost.	
134	Gateway shall work on 48V DC & 230 V AC and must have DC dual power supply in each cabinet.	
135	Analog: E&M (2W), E&M (4W), DTMF. Digital: 2Mb stream with the following signalling protocols (Digital CEPT, R2MFC)	
136	The system gateways should support the following type of trunks:- i. Analog:- E&M (2W/4W), DTMF, etc. ii. Digital:- CEPT,R2MFC ,Standard ISDN PRI,BRI,Q-Sig. etc.	
137	The system gateways should support the following type of Extensions: Analog, Digital, Trunk, PRI etc.	
138	Necessary interface cable to connect gateways to MDF/IDF patch panels must be provided for the wired capacity	
139	All other required necessary accessories for connecting multiple gateways to server should be provided by tenderer at installation and commissioning and operation of IP- server based communication system.	
140	Universal Slot Gateway (Minimum 16 slots) should be connected to telephony Server over LAN/ WAN and management of gateways to be done centrally from telephony Server.	
141	Universal Slot Gateway should support following cards:	
142	PRI/ E1	
143	Analog Extensions	
144	Digital Extensions	
145	CO Lines	
146	E1/PRI	
147	GSM	
148	E&M	
149	Gateway configuration	
150	Gateway must be equipped with all TDM interface along with 25% spares for future use	
151	Digital line card should have min 8/16/24 port. Analog card should have minimum 16/24/32 port card. Each port should support CLIP feature. It should work on 2 wire. Each GSM card should support minimum 2/4/8 SIM Trunk card should be with minimum 8 port per card	

S.No.	Technical Specification	Complied (Yes/No)
152	The gateway should be expandable upto 512 ports with minimum 16 universal slot (TDM port) each gateway.	
153	SIP Endpoint	
154	The IP telephony system shall support all standard SIP enabled third party IP Phone, OEM-IP/SIP Phone (end points), OEM-Mobile Clients (end points), OEM Soft clients & web based client on PC (end points) etc. All these OEM licenses of IPEPABX.	
155	Any third party SIP enabled phones should work with this solution having SIP/IP third party license. Basic call functionalities shall be supported on any third party SIP enabled IP Phones. OEM IP/SIP Phones shall have complete feature transparency. In addition the system shall support following SIP end points: OEM Mobile Clients: License of OEM Mobile client shall have full feature transparency. The system should support IP/SIP mobile clients on smart phones.	
156	There must be facility to install app on mobile phones (Android and IOS) and also to work with different telco operator along with multiple network to distribute the load or to use the alternate route in case of failure of primary network.	
157	UC should be with minimum features like like call forward, Call back /Missed call details/ Phone book/ Click to call / Text / VM / File Sharing over Web based.	
158	SIP Endpoints: Mobile clients, Softphone clients, IP/SIP phones should have mobility connected with IP-PBX users have mobility through Wi Fi and GSM network and they should act as same extension/parallel ringing clients.	
159	AUTOMATIC CALL DISTRIBUTION	
160	System should have built in Automatic Call Distribution (ACD) with following features for minimum 5 agents and 1 Supervisor. ACD should be from the same OEM. No 3rd party integration of ACD will be acceptable	
161	Busy ACD Group announcement	
162	Hunt Group Release	
163	IVR-ACD	
164	Log In / Log Out	
165	Multiple Announcements:	
166	1. Mandatory announcement - All incoming callers to an ACD/HUNT group must be able to hear an introductory announcement in its entirety usually explaining about the company, product, or campaign.	
167	2. First announcement - If all agents are busy, callers must be able to hear this announcement once usually informing them that their call has been placed in queue. (The system must be able to cut short this announcement if an agent becomes available to attend to the caller.)	
168	3. Music - If no agents are available after the first announcement (or no First and Periodic announcers have been configured), the caller must be able to hear background music while in queue.	
169	4. Periodic announcement - Alternating with background music, these announcements can also be played to callers in queue according to the Periodic Announcement Interval (see above) until the ACD/HUNT call is answered.	
170	MIS historical reporting and real time status on supervisor screen for agents should	
171	be available. Historical Reports must include an ACD calls accepted, missed,	
172	unanswered / overflowed, waiting in queue etc.	
173	AUDIO CONFERENCING	

S.No.	Technical Specification	Complied (Yes/No)
174	The Audio Conference System should have the facility to automatic dial out to connect 64 participants or more in single conference. Conference System should be From same OEM and no separate server should be used and Conference using browser based platform on redundant Server in HA mode. Conference System should also have 100 party managed meet me conference. It should be possible to further divide 100 party conference bridge into any combination like 32x3, 16 X 4 party, 8 x 8 party, unlimited 3 party etc. if required. The meet me conference should be secured means to enter to the conference bridge, the user should enter the password. This conference system must be controlled by an operator from the web based GUI.	
175	The Group Operator should have following features as below:	
176	1. The group operator must be able to add / remove conference members	
177	2. The group operator must be able to mute / unmute (User, None, All)	
178	3. The group operator must be able to lock / unlock the conference	
179	4. The group operator must be able to close the conference	
180	5. It must be possible to dial out a pre-defined group (or multi-groups) of participants/numbers by simply pressing the pre-assigned virtual key on PC.	
181	6. Each pre-set conference must have its own unique dial number such that when this group number is dialled; all the number stations will ring simultaneously.	
182	7. Participants may join a conference in the audible or in the mute mode, if in mute mode, the right to speak must be selectively offered to attendees per their request by a special signal sent to the Group Operator by the attendees.	
183	8. Attendees must be able to be added or excluded at any time by the Group Operator	
184	IP PHONE - Type 1	
185	Desktop Phone.	
186	Minimum 1 SIP Account	
187	Display: At least 2.1" Pixel display with backlight display	
188	Mute, Speaker & transfer button Must be available.	
189	Full-duplex speaker phone	
190	Features	
191	Hands free operation.	
192	Last numbers redial.	
193	Intercom	
194	On hook dialing.	
195	Conference.	
196	Ring volume control.	
197	Speaker volume control.	
198	Message waiting indication.	
199	Call forwarding.	
200	Automatic call back.	
201	Call line identification.	
202	Do not disturb.	
203	Call waiting.	
204	Boss secretary function.	
205	Missed Call and Dial Number Details	
206	Should have an integrated 2-port 10/100 base T Ethernet ports switch so as to allow connection of a PC directly to it and no separate cabling should be required for this.	
207	Fixed IP Address, DHCP allocated IP Address	
208	Should be compatible to SIP Signaling	
209	It should support PoE 802.3af.	
210	Details of Make & Model to be furnished.	

S.No.	Technical Specification	Complied (Yes/No)
211	11.a IP Phones must support the configuration of programmable buttons	
212	11.b HD Voice: HD Handset, HD Speaker	
213	IP PHONE - Type 2	
214	Desktop Phone.	
215	Minimum 4-line Account keys	
216	Display: 2.8" 320*240 graphical Color LCD with backlight which should display Calling party Name and Number at incoming call.	
217	Mute, Speaker & transfer button Must be available.	
218	Full-duplex speaker phone	
219	Features	
220	Hands free operation.	
221	Last numbers redial.	
222	Intercom	
223	On hook dialing.	
224	Conference.	
225	Ring volume control.	
226	Speaker volume control.	
227	Message waiting indication.	
228	Call forwarding.	
229	Automatic call back.	
230	Call line identification.	
231	Do not disturb.	
232	Call waiting.	
233	Boss secretary function.	
234	Missed Call and Dial Number Details	
235	Should have an integrated 2-port 10/100/1000 base T Ethernet ports switch so as to allow connection of a PC directly to it and no separate cabling should be required for this.	
236	Fixed IP Address, DHCP allocated IP Address	
237	Should be compatible to SIP Signaling	
238	It should support PoE: IEEE 802.3af, Class 1.	
239	Details of Make & Model to be furnished.	
240	11.a IP Phones must support the configuration of programmable buttons, with functions such as Break-in, Conference call, Camp-on, silent monitoring and more.	
241	11.b HD Voice: HD Handset, HD Speaker	
242	11.c Illuminated LEDs for line status	

2 MASTER ANTENNA TELEVISION SYSTEM

The system shall comprise the reception and distribution of VHF Broadcast signals through one Master Head Antenna through suitable cable network, to each individual outlet. The equipment shall be: Master Antenna, Master Head Antenna Pre-Amplifier, Broad Band (VHF-UHF) Amplifier/Mixer, Splitters and Directional Coupler, Wall Connectors/Terminations of Antenna Cables and Interconnecting low-loss MATV coaxial cables.

MATV systems allow multiple receivers (TV & FM) to receive signals from a single (Master) antenna, as opposed to individual antennas for each receiver. MATV systems are separated into two portions, the 'Head End' and the 'Distribution System'.

34.1. Master Antenna in MATV System

The Master Antenna shall be selected, as per as site location and requirement. The antenna shall be fixed on to the highest point of the building and shall be orientated for reception of maximum signal level. Construction of Master antenna shall be Outdoor type & weather protected. Frequency should be either VHF or UHF as required, and impedance to be 75 ohms.

34.2. Antenna Pre-Amplifier

The Master Pre-Amplifier shall be mounted on the Antenna Master. The Master PreAmplifier shall be of low noise, offering a gain of 15-25 dB or as required to boost the incoming signal to feed free signals to the main amplifier. Its construction shall be outdoor, totally enclosed type, frequency to be 40 MHz to 230 MHz/ 470-890 MHz, Input Impedance shall be 75 ohms, output Impedance shall be 75 ohms, gain should be between 15-25 dB, noise figures of 3 dB or similar, operating temp between -10 Degree C to 45 Degree C and electrical power supply should be 230 V, 50 HZ, AC.

34.3. Broad Band Amplifier / Mixer for MATV System

The Board Band Amplifier / Mixer shall be suitable for amplification of VHF / UHF signal strength sufficiently, to enable further distribution. The gain shall be adjustable over 40 dB, so that distribution voltage can be adjusted for weak signals as well as for strong signals. The amplifier shall have high noise rejection characteristics. The amplifier / mixer shall have common output with two separate inputs for VHF and UHF signals. Construction of broad band amplifier / mixer shall be indoor type, aluminium housing, input frequency should be separately given for both VHF and UHF, output to be single common, frequency bandwidth for VHF 40-230 MHz and UHF 470-860 MHz. Signal gain shall be 35 dB (VHF) and 40 dB (UHF), input Impedance to be 75 ohms, output impedance to 75 ohms, noise level shall be 3 dB for VHF and 4 dB UHF; operating temp to be -10 Degree C to 45 Degree C.

34.4. Splitters for MATV System

The splitters in Master Antenna System shall be for 2 way and 4 way output as required. The incoming signal shall be split into 2 or 4 equal signal outputs. The attenuation and mismatch shall be minimum. Construction of Splitters for MATV System to be indoor, totally enclosed type. It shall have 2/4 ways, 4/8 dB VHF insertion loss, 75 ohms impedance and F type cable termination.

34.5. Directional Couplers for MATV System

Directional couplers to be constructed suitable for indoor type, totally enclosed. No. of outputs to be 1/2, less than 3 dB insertion loss, 75 ohms input impedance, 75 ohms, output impedance, branch loss to be 12 dB for VHF and 14 dB for UHF and F type cable termination.

34.6. Wall Connectors of MATV System

The wall connectors shall be suitable for termination of TV Antenna co-axial plugconnectors, in positions shown in drawings. The outlets shall be recessed in walls, with the connectors fixed onto acrylic sheets.

34.7. MATV CABLE

The MATV cable shall be Co-axial, solid copper conductor PE insulated, shielded with fine tinned copper braid and protected with PVC Sheath. It shall be laid in the PVC conduit.

34.8. Specification of the devices shall be as following:-

RG 59 Dual Shield MATV Cable-

Conductor Size (mm)	(AWG)	Cond. Type	Shield Type	Reel Length (m)	Nom. O.D (m)	Insl. & Core O. D (mm)	Vel. of Prop (%)
.813	20	Solid BCCS	60% Aluminium Braids	305	6.02	3.66	83

RG6 Dual Shield MATV Cable

Conductor Size (mm)	(AWG)	Cond. Type	Shield Type	Reel Length (m)	Nom. O.D (m)	Insl. & Core O. D (mm)	Vel. of Prop (%)
1.02	18	Solid	60% Aluminium Braids	305	6.86	4.57	85

RG6 Tri Shield MATV Cable

Conductor Size (mm)	(AWG)	Cond. Type	Shield Type	Reel Length (m)	Nom. O.D (m)	Insl. & Core O. D (mm)	Vel. of Prop (%)
1.02	18	Solid BCCS	60% Aluminium Braids	305	6.86	4.57	85

RG6 Quad Shield MATV Cable

Conductor Size (mm)	(AWG)	Cond. Type	Shield Type	Reel Length (m)	Nom. O.D (m)	Insl. & Core O. D (mm)	Vel. of Prop (%)
1.02	18	Solid BCCS	60% & 40% Aluminium Braids	305	7.57	4.57	85

RG11 Quad Shield MATV Cable

Conductor Size (mm)	(AWG) Cond.	Shield Type	Reel Length (m)	Nom. O.D (m)	Insl. & Core O. D. (mm)	Vel. of Prop (%)
1.63	14	Solid 60% & 40% BCCS Aluminium Braids	305	11.34	7.1	83

24dB Wide-band VHF/UHF Amplifier

	Frequency Range	Maximum Gain (dB)	Inputs	Noise Figure	Gain Figure	Current (mA)	FM Trap Option	Pager Option	Output Figure (dB)
VHF	44-470 470-	18	1	<3	Tilt 1410	80	NO	NO	105
UHF	860	24 fixed comb	or	<3	NO	80	N/A	N/A	105

34dB Wide-band VHF/UHF Amplifier

	Frequency Range	Maximum Gain (dB)	Inputs	Noise Figure	Gain Figure	Current (mA)	FM Trap Option	Pager Option	Output Figure (dB)
VHF	44-230 520-	20-27	1,2	<3	Tilt 12-10	90	-24	-24	108
UHF	860	34	comb	<2.5	10	90	N/A	N/A	108

38dB Wide-band VHF/UHF Amplifier

	Frequency Range	Maximum Gain (dB)	Inputs	Noise Figure	Gain Figure	Current (mA)	FM Trap Option	Pager Option	Output Figure (dB)
VHF	44-230 470-	20-28	1,2	<3	10	100	33	25 (Freq.Adj)	110
UHF	860	24 fixed comb	or	<2.5	10	100	N/A	N/A	110

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19. DATA AND WI-FI SYSTEM

Technical Specification of L3 Core Switch

S.No.	Technical Specification		Complied (Yes/No)
1	Port Density	26 X 1/10G SFP Ports	
		2 x 40/100 G QSFP28 Ports	
2	Power Supply	Redundant Hot Swappable Power Supply - AC/DC	
3	Virtual Chassis/ Stacking Option	Upto 6 Switches or more	
4	RAM	8 GB or better	
5	Flash and Buffer	32GB or better and 32MB Packet Buffer	
6	Switching Capacity and forwarding Rate	900 Gbps or better and 600 Mpps or better	
7	Latency & MTBF	Latency: <650 ns MTBF: 384,636 h	
8	MAC Address	64K	
9	Routes	IPv4 - 32k or better IPv6 - 16k or better	
10	Quality of Service	Support for Egress rate limiting, eight egress queues per port, IEEE 802.1Q, 802.3x, DiffServ, Jumbo frame	
11	Protocol Support	IGMP Snooping V1, V2, V3, MLD, PIM-SM/PIM-SSM/PIM-DM/PIM-Bidirectional, DVMRP,RIPv1 & v2,RIPing ,OSPFv3, RIP, BGPv4, MP-BGP,GRE, IS-IS, ITU-T G.8032, IEEE 802.1s, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP), Ipv4/Ipv6, DHCP Option 82, BPDU, STP Root Guard, SIP detection, SPB-M or MPLS, IEEE 802.1ae, MIB, NTP, Built-in CPU protection against malicious attacks, The Switch Should have 1+N redundant supervisor manager in Virtual chassis with In-Service Software Upgrade (ISSU), VXLAN, ARP Poisoning detection, Policy based routing (PBR),SDN support through Restful API and OpenFlow 1.3.1	
12	Management	SNMP V1, V2, V3, Web GUI, CLI, USB or equivalent from approved make list memory card, IPv6 management feature on open standards, IEEE802.1ag, TDM or equivalent from approved make list standards	

S.No.	Technical Specification		Complied (Yes/No)
13	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS/ TACACS+, SSL, SSH, port mirroring, IEEE 1588, AES, Syslog, MD5, LLDP-MED, BPDU Blocking, BFD, Unified management, control and fabric-mesh virtual chassis technology, Autosensing IEEE 802.1X multi-client, multi-VLAN support for bridging and SPBM/VXLAN services, MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks	
14	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ITU-T G.8032 ring resilience/ring protection, VRRPv2,	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS	
		US UL 60950, CSA22.2	
		FIPS 140-2, EAL2 & NCPP Certified	
		EN 60825-1/2 Laser	
17	SFP	SFP should be of same make as switch.	
18		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image. The Switch should be EAL2/NDPP certified	

Technical Specification of Distribution Switch

S.No.	Parameters	Minimum specification	Complied (Yes/No)
1	Port Density	24 x 100/1000 BaseX, SFP and 4 x 1/10G SFP+	
		4 x 10/25G SFP28	
2	Power Supply	Redundant Hot Swappable Power Supply - AC/DC	
3	Virtual Chassis/ Stacking Option	Upto 8 Switches or more with 2 x 100G QSFP28 Virtual Chassis/Stacking ports per Switch	
4	RAM	4 GB or better	
5	Flash and Buffer	16 GB or better and 32MB Packet Buffer	
6	Switching Capacity and forwarding Rate	728 Gbps or better and 540 Mpps or better	
7	Macsec Support and MTBF	Macsec Support: All SFP ports should be macsec capable MTBF: 138,559 h	
8	MAC Address	64K	
9	Routes	IPv4 - 144k or better IPv6 - 72k or better	
10	Quality of Service	Support for Egress rate limiting, Eight egress queues per port, IEEE 802.1Q, 802.3x, DiffServ, Jumbo frame	
11	Protocol Support	IGMP Snooping V1, V2, V3, MLD, PIM-SM/PIM-SSM/PIM-DM/PIM-Bidirectional, DVMRP, RIPv1 & v2, RIPv2, OSPFv3, RIP, BGPv4, MP-BGP, GRE, IS-IS, ITU-T G.8032, IEEE 802.1s, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP), Ipv4/Ipv6, DHCP Option 82, BPDU, STP Root Guard, SIP detection, SPB-M or MPLS, IEEE 802.1ae, MIB,	

S.No.	Parameters	Minimum specification	Complied (Yes/No)
		NTP,Built-in CPU protection against malicious attacks,The Switch Should have 1+N redundant supervisor manager in Virtual chassis with In-Service Software Upgrade (ISSU), VXLAN, ARP Poisoning detection, Policy based routing (PBR),SDN support through Restful API and openflow 1.3.1	
12	Management	SNMP V1,V2,V3, Web GUI, CLI, USB or equivalent from approved make list memory card, IPv6 management feature on open standards, IEEE802.1ag, TDM or equivalent from approved make list standards,Smart continuous switching technology	
13	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS/ TACACS+, SSL, SSH, port mirroring,NTP, IEEE 1588, AES, Syslog, MD5, LLDP-MED, BPDU Blocking, BFD, Unified management, control and fabric-mesh virtual chassis technology, Autosensing IEEE 802.1X multi- client, multi-VLAN support for bridging and SPBM/VXLAN services,MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks	
14	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ITU-T G.8032 ring resilience/ring protection, VRRPv2, MVRP, VRF and Virtual Network Profiles (VNP),Software-controlled VXLAN hardware VTEP gateway	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS US UL 60950, CSA22.2 FIPS 140-2, EAL2 & NDcPP Certified EN 60825-1/2 Laser	
17	SFP	SFP should be of same make as switch.	
18		Vendor to be present in Gartner Magic Quadrant.	
19		The Switch shall work with on-premise and cloud based NMS without change in hardware/software/OS Image. The Switch should be EAL2/NDPP certified	
20		5 Years from OEM with Toll free number for support in India	

Technical Specification of L2 Access PoE Switch

S.No.	Parameters	Minimum specification	Complied (Yes/No)
1	Port Density	24 X 1G RJ-45 Ports with 180W power budget 2 x 1G/10G SFP+ Ports and 2 x 1G SFP/Base-T Combo Ports	
2	Power Supply	Internal Power Supply	
3	Virtual Chassis/ Stacking Option	Upto 4 Switches or more	
4	RAM	1 GB or better	
5	Flash	1 GB or better	
6	Switching Capacity and forwarding Rate	92 Gbps or better and 68 Mpps or better	

S.No.	Parameters	Minimum specification	Complied (Yes/No)
7	Latency & MTBF	Latency: < 4 μs MTBF: 2595 k hours	
8	Layer 2 Features	Mac Address:16K or more VLAN: 4K or more System Policies: 1.5K or more Max Jumbo Frame: 9216 bytes Multicast Group: up to 1000	
10	Quality of Service	Auto QoS for switch management traffic, Policy-based QoS, Traffic Prioritization, Priority Queues: Eight hardware-based queues per port, SPQ, WRR	
11	Protocol Support	Static Routing, MSTP, RSTP, PVST+,IPv6 Tunneling, LACP, LAG, IGMPv3, DHCP, DHCP82,DHCP Relay for IPv4/IPv6,Multiple microcode image support with fallback recovery, ARP,SDN support through Restful API and openflow 1.3.1	
12	Management	Loopback IP address support for management per service, Policy- and port-based mirroring, Remote port mirroring, sFlow v5 and Remote Monitoring (RMON), Unidirectional Link Detection (UDLD), Digital Diagnostic Monitoring (DDM), LLDP-MED, NTP,MVRP, SNMP, sflow or equivalent from approved make list	
13	Security	Dynamic change of authentication (CoA), MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks, Web based Authentication, Autosensing IEEE 802.1X multi-client, multi-VLAN support, RFC 1321 MD5, RFC 2284 PPP EAP,RFC 1826/1827/4303/4305 Encapsulating Payload (ESP) and crypto algorithms, RFC 2104 HMAC Message Authentication, Built-in CPU protection against malicious attacks	
14	Resiliency	Unified management, control and virtual chassis technology, Virtual Chassis 1+N redundant supervisor manager, Virtual Chassis In-Service Software Upgrade (ISSU), Smart continuous switching technology, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP) and static LAG groups across modules	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS, WEEE	
		US UL 60950, CSA22.2	
		FIPS 140-2	
		EN 60825-1/2 Laser, IEC 62368-1	
17	SFP	SFP should be of same make as switch.	
18		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image.	

Technical Specification of Indoor Access Point

S.No.	Technical Specification	Complied (Yes/No)
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1	Proposed solution will be Controller less/HW Controller based/SW Controller based but all the Access Points managed centralized.	
2	The WLAN solution shall propose an Indoor 802.11ax Wi-Fi 6 MU-MIMO indoor dual radio AP Access Point (2.4, 5G)	
3	AP to support 4X4:4 on 5 Ghz and 2X2:2 on 2.4 Ghz.	
4	Access Point shall offer up to 2400 Mbps throughput on the 5Ghz band (low and high bands) and up to 573 Mbps throughput on the 2.4GHz band.	
5	1 x 10/100/1000Base-T autosensing (RJ-45) port and 1x 10BASE-Te/100BASE-TX/1000BASE-T/2500BASE-T IEEE 802.3 compliant autosensing (RJ-45) port. Both ports should support 802.3at PoE,1x USB 2.0 Type C	
6	AP should support ACL, wIPS/wIDS and DPI application, 802.11i, 802.1x	
7	Access Point shall propose a Factory reset button.	
8	Access Point shall support up to 32 SSIDs (16 per radio) with 1024 Clients and should support BLE 5.1/Zigbee Integrated. Single AP can act in dual mode (WLC/Client Serving) with controller to support 256 Access Points in single cluster.	
9	Distributed Radio Management, Radio Dynamic Adjustment (RDA), Transmit Power Control @ 18 dBm(TPC), DFS, VHT20,40,80,160	
10	L2 Roaming	
11	802.11r Roaming, 802.11K, 802.11v	
12	Operating temperature must be 0°C to 50°C	
13	Humidity must be 10% to 90% non-condensing.	
14	WFA, UL2043 Plenum rating, EMI, RoHS, REACH, WEEE	
15	FCC and CE, WPC approved	
16	The AP shall work with on-premises and cloud based WLC without change in hardware/software/OS Image	

Technical Specification of Outdoor Access Point

S.No.	Technical Specification	Complied (Yes/No)
1	Proposed solution will be Controller less/HW Controller based/SW Controller based but all the Access Points managed centralized.	
2	The WLAN solution shall propose an outdoor 802.11ax Wi-Fi 6 MU-MIMO indoor dual radio AP Access Point (2.4, 5G)	
3	AP to support 4X4:4 on 5 Ghz and 2X2:2 on 2.4 Ghz and dedicated scanning radio	
4	Access Point shall offer up to 2400 Mbps throughput on the 5Ghz band (low and high bands) and up to 573 Mbps throughput on the 2.4GHz band.	
5	1 x 10/100/1000Base-T autosensing (RJ-45) port and 1x 10BASE-Te/100BASE-TX/1000BASE-T/2500BASE-T IEEE 802.3 compliant autosensing (RJ-45) port. Both ports should support 802.3at PoE and 1 x 1G SFP Port, 1x USB 2.0 Type C (5V, 1A)	
6	AP should support ACL, wIPS/wIDS and DPI application, 802.11i, 802.1x	
7	Access Point shall propose a Factory reset button.	
8	Access Point shall support up to 32 SSIDs (16 per radio) with 1024 Clients and should support BLE 5.1/Zigbee Integrated. Single AP can act in dual mode (WLC/Client Serving) with controller to support 256 Access Points in single cluster.	
9	Distributed Radio Management, Radio Dynamic Adjustment (RDA), Transmit Power Control @ 18 dBm(TPC), DFS, VHT20,40,80,160	

S.No.	Technical Specification	Complied (Yes/No)
10	Integrated vertically polarized omnidirectional antenna with Advanced Cellular Coexistence (ACC) i.e Minimizes interference from 3G/4G cellular networks, distributed antenna systems, and commercial small cell/femtocell equipment	
11	L2 Roaming	
12	802.11r Roaming, 802.11K, 802.11v	
13	Operating temperature must be -40°C to 65°C	
14	Humidity must be 10% to 90% non-condensing.	
15	WFA, UL2043 Plenum rating, EMI, RoHS, REACH, WEEE	
16	FCC and CE approval and WPC certificates,	
17	The AP shall work with on-premises and cloud based WLC without change in hardware/software/OS Image	
18	Toll free number for support in India	

Technical Specification of Wireless Controller

S.No.	Technical Specification	Complied (Yes/No)
1	Architecture	
2	Redundant Controller should be appliance or server (physical or virtual) based to support upto 4000 AP or more. The proposed solution should be premise based and not cloud based	
3	Access Control	
4	Authentication and Encryption For this "large deployment" scenario, the WLAN solution shall include a built-in RADIUS server for 802.1x and MAC authentication that shall not be proposed as a separate product.	
5	The built-in RADIUS server shall support at least following EAP types: EAP-PEAP, EAP-GTC, EAP-TLS, EAP-TTLS.	
6	The wireless LAN solution shall support following link layer encryption standards: WPA2_AES, WPA2_TKIP, WPA_AES, WPA_TKIP, DYNAMIC_WEP, WPA_PSK_AES, WPA_PSK_TKIP, WPA_PSK_AES_TKIP, WPA2_PSK_AES, WPA2_PSK_TKIP.	
7	The wireless LAN solution shall support following 802.1x supplicants: Windows 7, 10, MAC OS, IOS, Android, Chromebook	
8	the wireless LAN solution shall propose a "Guest" management solution based on an embedded and built-in Captive Portal providing web based authentication for guests and visitors.	
9	The Guest management solution shall allow non-IT staff (e.g., a receptionist) to create temporary guest accounts.	
10	The WLAN solution shall allow guest self-registration and employee sponsored access.	
11	The Guest management solution shall allow setting a validity period for an authenticated device, in order to avoid entering credentials each time a guest access the network	
12	The WLAN solution shall support BYOD and be able to provide device onboarding that is as simple as possible and without requiring additional thirdparty components	
13	The on-boarding process of employee devices shall be based on employee corporate accounts.	
14	The BYOD application shall allow setting the validity period for the device, and the maximum number of devices per account.	
15	The licensing model of the BYOD application shall be based on the number of on-boarded devices.	

S.No.	Technical Specification	Complied (Yes/No)
16	Intrusion Detection and Prevention	
17	The WLAN solution have wIDS/wIPS capabilities with no additional and dedicated equipment nor additional license.	
18	The WLAN solution shall be able to identify Interfering APs.	
19	The WLAN solution shall be able to identify and contain Rogue APs.	
20	The WLAN solution shall allow the definition of flexible policies to classify an AP as a Rogue AP.	
21	the WLAN solution shall be able to blacklist a WLAN client, either manually or automatically after a client attack has been detected.	
22	the WLAN solution shall allow to configure a blacklist duration.	
23	the WLAN solution shall allow to configure an authentication failure times threshold.	
24	RF Management	
25	The WLAN solution shall allow automatic and/or manual RF management (channel and power).	
26	The WLAN solution shall support Short Guard Interval.	
27	If no band/channel (2.4GHz/5GHz) is overloaded (high medium utilization) or crowded (high client count), an AP shall by default guide a new client to the 5GHz band.	
28	Even if the 5GHz band is not overloaded but is crowded (high client count), an AP shall guide a new client to the 2.4GHz band.	
29	If all bands/channels (2.4GHz/5GHz) are overloaded (high medium utilization) and the 5GHz is crowded, an AP shall guide a new client to the 2.4GHz band.	
30	When a new client discovers multiple APs to associate to, the new client shall be guided to the AP that has the fewest associated clients, thus allowing smart/dynamic load balancing.	
31	The WLAN solution shall deny connection to an AP when the signal of the client becomes too weak and disconnect a client when the signal becomes too weak.	
32	The WLAN solution shall propose APs that have the ability to scan the air in order to provide interfering/rogue APs and wireless attacks detection, and shall not rely on dedicated scanning equipment.	
33	The scanning function of the APs shall not impact active voice or video calls (SIP and H.323).	
34	Mobility & LBS	
35	The WLAN solution shall support both Opportunistic Key Caching (802.11k).	
36	The WLAN solution shall comply with the 802.11r standard.	
37	The centralized management function shall allow to display the Wi-Fi coverage quality within a given area ("Heat Map").	

Technical Specification of Network Management System (NMS)

S.No.	Technical Specification	Complied (Yes/No)
1	GENERAL	
2	A redundant solution that shall include a client/server Network Management System that is WEB 2.0 based, providing a WEB GUI for different types of PCs, tablets, and smartphones.	
3	The NMS shall offer a single and consolidated interface for network deployment, troubleshooting, performance analysis and configuration operations.	

S.No.	Technical Specification	Complied (Yes/No)
4	The NMS shall offer northbound interface RESTful APIs for application interoperability	
5	The NMS shall allow real-time monitoring and analysis of critical network performance indicators through visual and customizable widgets	
6	The proposed solution should be premise based and should support seamless migration to cloud without change in hardware/firmware of the switch. This should be based on standard server (Physical/Virtual)	
7	The centralized management function shall allow to display the physical topology of the network.	
8	The centralized management function shall be able to handle wired equipment (switches) and wireless (Access Point) management for a "unified management" approach.	
9	The solution shall be able to automatically discover new Switch or APs added to the network.	
10	The solution shall be able to blacklist a client, either manually or automatically after a client attack has been detected.	
11	The centralized management function shall allow per equipment configuration and software backup and restore, and bulk backup and restore.	
12	TOPOLOGY	
13	The NMS shall build and present a visual topology for both logical and physical infrastructure with actual neighbour linkage info (IP subnet, layer 2, LLDP adjacency protocols) and live device status	
14	The NMS shall present logical maps based on user-defined filters (IP subnet, location...).	
15	NOTIFICATION MANAGER	
16	The NMS shall allow monitoring and analysing alerts, notifications and network performance from network equipment from any vendor	
17	The NMS shall offer advanced alert capabilities through customizable filtering and sorting capabilities.	
18	The NMS shall allow remediation and notifications actions based on predefined conditions with a single click	
19	LOCATOR	
20	The NMS shall be able to locate devices in the network based on MAC address or IP Address, irrespective whether the device is located on a fixed or wireless network.	
21	RESSOURCE MANAGER	
22	The NMS shall allow mass programmable equipment configuration by the mean of scripts.	
23	The NMS shall allow infrastructure-wide software image update for baseline version management	
24	UNIFIED ACCESS	
25	The NMS shall offer a unified user interface for wired and wireless role profiles for user based access	
26	The NMS shall offer a wired and wireless cohesive authentication configuration and end-user profile definition for appropriate network access rights and dynamic policies	
27	ADDATIONAL FEATURES	
28	The centralized management function shall allow access to all wIPS/wIDS features.	

S.No.	Technical Specification	Complied (Yes/No)
29	The centralized management function shall offer, on the basis of an application signature file, insight at application layer (e.g. facebook.com, youtube.com, salesforce.com...) even if the applications run on top of the HTTP or HTTPs protocols. It shall also allow control of those applications.	
30	The solution should allow the admin to easily provision, manage and maintain a network infrastructure with alarms, unified access security policies	
31	The solution should provide full visibility into wireless, devices and applications, as well as predictive analysis for forward planning	
32	The management solution should act as comprehensive tools for infrastructure configuration, monitoring, security, device configuration, alert management, to accelerate, downtime resolution, and overall management.	
33	It should be web-based interface with customizable dash board	
34	Provide details about problematic devices including temperature, memory etc	
35	Monitor network bandwidth and end device traffic pattern	
36	Provide top applications/users usage analytics real time and historical	
37	Port utilisation details and threshold limits	
38	Provides threat mitigation through a secure perimeter against intrusion and malware attacks	
39	Should support third party network devices for basic SNMP and report	

Technical Specification of SM 40-Gigabit QSFP+ Module

S.No.	Technical Specification	Complied (Yes/No)
1	Connector Type	LC
2	Standards Supported	802.3ba, QSFP+ MSA
3	Connections supported	40GBASE-LR4
4	Fiber Type	SMF
5	Wavelength(nm)	1264.5 - 1277.5 1284.5 - 1297.5 1304.5 - 1317.5 1324.5 - 1337.5
6	Optical Power Output	-7.0 to +2.3 dBm
7	Receiver Sensitivity	-11.5 dBm
8	Transmission Distance	10 km
9	Operating Temperature	0 °C to 70°C
10	Digital Diagnostic Monitoring to be Supported	Yes

Technical Specification of 10G SM SFP+ Module

S.No.	Technical Specification		Complied (Yes/No)
1	Connector Type	LC	
2	Standards Supported	802.3 Clause 52	
3	Connections supported	10GBASE-LR	
4	Fiber Type	SMF	
5	Wavelength(nm)	1310 nm	
6	Optical Power Output	-8.2 to 0.5 dBm	
7	Receiver Sensitivity	-10.3 dBm	
8	Transmission Distance	10 km	
9	Operating Temperature	-5 °C to 70°C	
10	Digital Diagnostic Monitoring Supported	Yes	

Technical Specification of 1G SM SFP Module

S.No.	Parameters	Minimum specification	Complied (Yes/No)
1	Connector Type	LC	
2	Standards Supported	802.3z, SFP MSA	
3	Connections supported	1000 BASE-LR	
4	Fiber Type	SMF	
5	Wavelength(nm)	1310 nm	
6	Optical Power Output	-9.5 to -3 dBm	
7	Receiver Sensitivity	(-19 dBm)	
8	Transmission Distance	10 km	
9	Operating Temperature	(-5 °C to 85°C)	
10	Digital Diagnostic Monitoring Supported	Yes	

Technical Specification of Firewall

S.No.	Technical Specification	Complied (Yes/No)
1	Supply of Unified gateway with versatile functions including full Unified management and VPN feature. With this one box, customer is able to protect and manage their network. Installation and supply of Security Gateway which is empowered by AI to level up network protection and tackles unknown t, empowered by cloud intelligence to level up network protection and tackles unknown threats, and also should have capability of all security services such as Web security, Application Security, Malware Blocker, Reputation Filter, etc., but also sandboxing and SecuReporter with infographic dashboard.	
2	Device should support Intelligence Machine learning ecosystem that can strengthen it's defuse and stay immune to new unknown attacks.	
3	Device should support Hybrid Scanning (stream-based engine and a cloud query running simultaneously) for Levelling up Malware blocking to maximize malware detection rate.	

S.No.	Technical Specification	Complied (Yes/No)
4	Device should support Reporting applications to sees, analyses, and reports network threats so admin can be advised what security actions to take.	
5	Device should be equipped with 3 years licences from day one	
6	Device should support billion of signature with cloud database from threat management	
7	Device should be cooperate with world leading threat management company to provide state-of-art protection.	
8	Device should support more than 100 categories to provide Web Filtering services	
9	Device Should contains comprehensive security features like URL threat filter, Application patrol, Web filtering, anti-malware, and IPS.	
10	Gateway dashboard gives user-friendly traffic summary and threat statistic visuals. Utilize Reporting application for a suite of analysis and reporting tools, including network security threats identification/ analysis, security services, security events, application usage, website usage, and traffic usage. URL threat filter analytics/report show top N malicious websites and their type, list which internal hosts are controlled by botnet web sites.	
11	Device should support Cloud based/single pane management	
12	Device should have minimum 14x 1Gigabit ethernet port including atleast 2x SFP ports which are should be configurable for WAN or LAN..	
13	Device should support USB3.0 interface to connect 3G or 4G internet for backup, or to connect USB drive to collect the device logs	
14	Device should be 19" Rack-mountable and should have RS232 Console port for recovery and configurations.	
15	Device should support 100-240 V AC Power input supply	
16	ICSA Labs firewall security certification	
17	Device should support SSL inspection and 2-Factor Authentication	
18	Device must provide an alert service for any problems with the service being unavailable. This can be in the form of SMS / E-Mails and should be sent to administrator,	
19	Device should support IPSec VPN for site to site connectivity and L2TP & SSL for Gateway to client communication.	
20	Device also should support GRE tunnel to make the routing protocol transparent between IPSec peers, also should support Routing based VPN Tunnel interface (VTI)	
21	Device also should support Source NAT over IPSec to make able to make tunnel between two sites if both sites has same LAN interface IP address.	
22	Device should support IKEv2 to negotiates and authenticates IPsec SAs and provides secure VPN communication channels between the gateway devices.	
23	Supports the securing of Stream Control Transmission Protocol (SCTP) protocol.	
24	Device should support security mechanism to identifies and automatically stop threats at the network edge by blocking or quarantining, preventing damage to the network. and these blocked and quarantined devices should be added in the list and that list should be displayed in the containment lists.	
25	Device should support 8Gbps firewall throughput and 1450 VPN throughput or better	
26	Maximum throughput based on RFC 2544 (1,518-byte UDP packets) and VPN throughput measured based on RFC 2544 (1,424-byte UDP packets)	
27	Device should have minimum 2 million concurrent session or better	
28	Device should support Controller feature to manage (minimum 500 Access point or better) in order to minimise the cost of additional access point controller.	

S.No.	Technical Specification	Complied (Yes/No)
29	Maximum VPN IPSec tunnel should support 1000 or better, and SSL VPN users 400 from day one.	
30	Device should have capability to create VPN tunnel with Microsoft Azure and Amazon Web Services	
31	Firewall should have support with X.509 (PKI infrastructure)	
32	Device should support IEC61000-3-2:2014 certificate to deals with the limitation of harmonic currents injected into the public supply system.	
33	Device should support EN55024:2010 certificate which defines the immunity test requirements for information technology equipment in relation to continuous and transient conducted and radiated disturbances	
34	Device should support RoHS EN IEC63000:2018	
35	Device should support EN 62368-1 certificate which is a product safety standard that alters the product compliance landscape for Information technology equipment	
36	Device should support MTBF 980000 Hours or better	

Note: - Voice and data communication system may share same IT infrastructure backbone.

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20. IP BASED CCTV SYSTEM

The Entire surveillance system is proposed to control and monitors the different buildings of IIT Campus. All the buildings shall have IP Based Dome/Bullet (Fixed /Motorized Varifocal) Camera indoor and Outdoor type security cameras and PTZ Cameras for outdoor surveillance. The different types of cameras shall be provided at locations as mentioned.

The indoor Dome Cameras and Bullet Cameras are proposed to be installed at all Entry & Exit Points in Ground floor. And in other Floors these cameras will be fixed in corridors, Lift Lobby & staircase entrances.

All the outdoor cameras shall be in IP 67 Housing and Junction box, power supply unit, media converter etc. are proposed in dust proof housing. The existing LAN network switches would be used for CCTV connectivity and will be connected to central CCTV server & cameras shall have POE connectivity ports. The power supply to LAN switches will be on UPS. The video recording shall be Network Video Management System with RAID supported Storage.

Control Room shall be located in the Hospital block in the Security /Control Room. The wiring inside the building shall be with CAT 6A cable in MS conduit and armored fiber Optic Cable and Outdoor connectivity shall be under ground in HDPE pipes with suitable Manholes for proper Maintenance of the system. PTZ cameras will be placed on roof top and Street light Poles in external areas. The video management server should have minimum 30 days storing capacity.

1. Camera Should comply with the NDAA Compliant.
2. The cameras should not have unsecured/backdoor protocol such as GB/T 281814 which can potentially give access to any government/ Agency/ Private company of neighboring/ foreign country to access the cameras without end-user permission.
3. The cameras should have TLS 1.2.
4. The cameras should support digest authentication feature which shall encrypt the user credential before transmitting over the network.

TECHNICAL SPECIFICATION FOR IP BASED CCTV SYSTEM

Technical Specification of Single Mode OS2 Fiber Cable:

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make:	To be Specified by the Bidder	
2	Quoted Model:	To be Specified by the Bidder	
3	Type	6F Core Single mode (9/125µm) G652 Fiber optic Outdoor Cable	
4	Cable	6F Core Single Mode Uniloose Tube, Single Sheath, Fiber cable is perfectly suited for both gigabit Ethernet and 10 gigabit Ethernet campus and backbone applications	
5	Application	Cable are perfectly suited for both gigabit Ethernet and 10 gigabit Ethernet campus and backbone applications.	
6	Outer Sheath	UV Resistance LSZH Jacket / Black	
7	No. of Tube / Tube diameter	1 / 3.0 ± 0.1 mm	
8	Water Blocking Material	WS Tape	
9	Loose Tube Construction	Std. plywood reel: Uniloose Tube, Water Blocking with fibres. Individually colour coded optical fibres as per Global Standards	
10	Cable Specifications	Fiber Color/ Fibers per Tube: Blue, Orange, Green, Brown, Grey, White, Red, Black, Yellow, Violet, Pink, Aqua	

S.No.	Parameter	Specification	Complied (Yes/No)
		Cable diameter: 9.0 ± 0.5 mm	
11	Optical Properties	Core non-circularity: ≤ 6 %	
		Cladding Diameter: 125.0 ± 0.7 μm	
		Core/cladding Concentricity Error: ≤ 0.6μm	
		Cladding non-circularity: ≤ 1.0 %	
		Primary Coating Diameter: 245±10μm	
		Coating/cladding Concentricity Error: ≤ 12μm	
		Attenuation Co-efficient	
		1310 Wavelength (nm): ≤0.36 dB/km	
		1550 Wavelength (nm): ≤0.24 dB/km	
		1625 Wavelength (nm): ≤0.26 dB/km	
		Chromatic dispersion:	
		1285 ~ 1330nm ≤ 3.4ps/(nm·km)	
		1550nm ≤18 ps/(nm·km)	
		1625nm ≤ 22 ps/(nm·km)	
		Cutoff Wavelength ≤ 1260 nm	
		PMDQ (Quadrature average*): ≤ 0.20 ps//km ^{1/2}	
		MFD: 9.1 ± 0.4 μm at 1310nm	
MFD: 10.3 ± 0.5 μm at 1550nm			
Zero dispersion slope: ≤ 0.092ps/(nm ² ·km)			
Zero dispersion wavelength: 1300~1324nm			
12	Temperature Range	Storage Temperature Range: -40°C to +70°C	
		Installation Temperature Range: -10°C to +70°C	
		Operating Temperature Range: -40°C to +70 °C	
13	Physical Properties	Complies to ANSI/TIA-568.3-D, ITU-T G652.D, Telcordia GR-20, IEC 60794-2, ISO/IEC 11801, ISO/IEC 24702	
		Cable Bend Radius: 20 x Cable Diam.	
		Cable Kink Radius: 10 x Cable Diam.	
		Cable Max. Tensile Strength (Short Term): 1500 N	
		Cable Max. Crush Resistance (Short Term): 2000 N / 100mm	
Impact Resistance: 25 Nm			
14	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of 6/12/24/48 Fiber Patch Panel LIU

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make:	To be Specified by the Bidder	
2	Quoted Model:	To be Specified by the Bidder	
3	Type	1U Rack Mount Fiber Enclosure (LIU) including Splice Trays and Adapter Strips which accepts loose tube & distribution cable	
4	Fiber Interface Unit	Fiber Patch Panel Typically used in Server rooms, Network rooms, Data Centres and Small offices Can be mounted directly on any 19" rack or cabinet. It should be able to accommodate a variety of Fiber connectors and terminated to fiber cables using Splicing or other methods.	
5	Type	Fiber LIU should be 1U, 19 Inch Rack Mount.	

S.No.	Parameter	Specification	Complied (Yes/No)
		6/12/24/48 Port should be available in 1U Rack Mount LIU.	
6	Features & Compatibility	The Fiber Panels are designed with fixed mount adapter plate assemblies.	
		Sliding design, this panel allows easy access during installation or rework without disturbing previously terminated fiber cable.	
		This also offers multiple cable entries to provide various customized solutions as per the customers' requirement.	
		This panel comes with adaptor plates which are preloaded with coupler and can snap in for installation and can be removed easily for future changes.	
		900m Tight buffer pigtails are provided with this panel. This panel is preloaded with Splice tray & necessary fiber management accessories.	
		4 Nos of 20mm diameter at the rear for Cable entries	
7	Material	Panel be constructed with SPCC (Cold rolled steel sheet)	
8	Standards	Conformance to Single Mode (ANSI/TIA-568.3-D, Telcordia GR-326-CORE, Telcordia GR-1221-CORE, ISO/IEC 11801, IEC 61754 & IEC 61300 series), Multi-Mode (ANSI/TIA-568.3-D, IEC 61300-3-4, IEC 61300-3-6, IEC 60874-1, ISO/IEC 11801)	
9	Adapter Types	Pigtails consist of LC, SC, FC, ST, MTRJ, and E2000 Connectors.	
10	Pigtails Type	Pigtails shall be constructed with bend Insensitive Fiber	
11	Insertion Loss	≤0.2 dB (Singlemode), ≤0.3 dB (Multimode)	
12	Return Loss	≥50 dB (UPC), (Singlemode), ≥60 dB (APC) (Singlemode), ≥35 dB (UPC) (Multimode),	
13	Repeatability	≤0.1dB	
14	Durability	≤0.2 dB, 1000mattings	
15	Ferrule Material	Zirconia Ceramic	
16	Operating Temperature	-25 °C to +70 °C	
17	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of LC-LC/LC-SC Fiber Patch Cord

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make:	To be Specified by the Bidder	
2	Quoted Model:	To be Specified by the Bidder	
3	Features	The armored patch cord uses metal tube inside the outer jacket as an armor to protect the fiber glass inside	
		The protective layer of Metal braiding is adopted, which has excellent side pressure resistance, flexibility and bending performance.	
		Good mechanical and temperature characteristics.	
		Small diameter, lightweight, easy to connect and support large capacity data transmission.	
4	Fiber Count	2	

S.No.	Parameter	Specification	Complied (Yes/No)
5	Outer jacket OD	3.0 mm X 2	
6	Metal tube OD	1.4 ± 0.3 mm	
7	Insertion Loss	≤0.2 dB (Singlemode), ≤0.3 dB (Multimode)	
8	Return Loss	≥50 dB (UPC), (Singlemode), ≥60 dB (APC) (Singlemode), ≥35 dB (UPC) (Multimode),	
9	Durability	≤0.2 (1000 mattings)	
10	Minimum allowable Tensile strength(N)	500 (short Term),300(Long Term)	
12	Minimum allowable Crush Load strength(N/100mm)	3000 (short Term),2000(Long Term)	
13	Minimum bending radius(mm)	20D (short Term),10D (Long Term)	
14	Operating Temperature	-20°C to + 75°C	
15	Storage Temperature	-20°C to + 85°C	
16	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of CAT6 U/UTP LSZH Cable

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make:	To be Specified by the Bidder	
2	Quoted Model:	To be Specified by the Bidder	
3	Type	CAT6 U/UTP LSZH Cable	
4	Type	23 AWG solid bard copper, Unshielded Twisted 4 Pair, Category 6, confirming to ANSI-TIA 568.2-D for Category 6 & ISO/IEC 11801 for Class E.	
5	Conductors	Solid bare copper 23 AWG	
6	Pair Separator	+ Shape Spline	
7	Packing	Box of 305 meters	
8	Cable Outer Diameter	6.0 ± 0.2 mm	
9	Delay Skew	< 45 ns	
10	Conductor Resistance	≤ 93.8 Ω/km	
11	Pulling Force	25 lb	
12	Nom. Velocity of Propagation	69%	
13	Temperature Range Storage	-20 °C to +70 °C	
14	Flame Properties	Flammability Test: IEC 60332-1	
		Acid Gas Emission Test: IEC 60754-1	
		Smoke Density Test: ASTM 2843	
15	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Should be tested by ETL IEEE Std 802.3btTM for Type 4 remote powering applications	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of CAT6 Patch Panel

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	24 Port, 1U Staggered Patch Panel, Unloaded - 1U	
4	Type	24 Port 1U Unloaded ZigZag / Staggered Patch Panel The design reduces Alien Crosstalk to support IEEE 802.3an and ANSI/TIA 568.2-D.	
		Patch panels IDC (IDC of Information Outlet) Connectivity Snap in Type should be at rear end & RJ-45 jack on front panel, 19" rack mountable.	
		Patch panels Ports should be individually replaceable & Consistent port-to-port performance and includes grounding bolt	
5	Availability	Patch Panel should be available with 24 Ports in 1U	
6	Cable management	Straight Patch Panel with Angled Information Outlet Slot that makes patch cord routing easier and eliminate the need for Horizontal Cable Management.	
7	Compatibility	Patch Panel should be able to accept Cat6A, Cat6 and Cat5e information outlets for backward and forward compatibility	
8	Height	1U (1.75")	
9	Storage Temperature Range	-40Deg C to +70 Deg C	
10	Operating Temperature range	-10Deg C to +60 Deg C	
11	Humidity	10% - 90% RH	
12	Color and Material	Metal SPCC, Black, plastic inserts, Double layer - 1.5mm, provided with mini cable ties, cage nuts & rare cable management.	
13	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Shall be tested for Corrosion as per ASTM B117: 2019. (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of CAT6 I/O (Information Outlet)

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make:	To be Specified by the Bidder	
2	Quoted Model:	To be Specified by the Bidder	
3	Type	CAT6 Modular Jack	

S.No.	Parameter	Specification	Complied (Yes/No)
4	Type	Modular Jacks shall meet and exceed channel specification of ANSI/TIA 568.D-2, IEC/ISO 11801 & IEC 60603-7-41 when used as a component in a properly installed UTP channel.	
5	Housing Material	High impact Fireproof ABS UL94V-0	
6	Front Connection	RJ 45: PCB, 50μ Phosphor bronze gold over nickel plating contacts	
7	IDC Connector	Phosphor bronze, Tin-plating contacts	
8	PCB Material & Thickness	FR-4, 1.2mm thickness	
9	Termination Interface	Front Mated Connection: 750 Cycles	
		Rear Mated Connection: 200 Cycles	
10	Plug and Outlet Contact force	≥ 100 Grams with FCC Compliant RJ-45 plug	
11	Plug retention Force	≥ 11lbf	
12	Jack wire material and thickness	0.35mm Phosphor bronze gold over nickel plating	
13	IDC Conductor	0.5mm Phosphor bronze, Tin-plating	
14	Contact Compatibility	Accommodates 23 to 26AWG solid	
15	Termination Pattern	TIA / EIA 568 A and B	
16	Storage Temperature:	-40° to +70°C	
18	Electrical Performance	Insulation Resistance: ≥ 500mΩ	
		Contact Resistance: ≤10mΩ	
		Current rating: 1.5 Amps	
		DC Resistance: ≤ 0.1Ω	
		DC/AC Volt Endurance: DC1000V/AC750V 1min	
19	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of CAT 6 Patch Cord

S.No.	Parameter	Specification	Complied (Yes/No)
1	Type	CAT6 Unshielded Modular Cord shall meet and exceed channel specification of ANSI/TIA 568.2-D, ISO/IEC 11801 Standard.	
2	Conductor	Flexible Stranded Bare Copper, 24 AWG	
3	Jacket thickness	0.6 ± 0.02mm with LSZH jacket manufactured using an antibacterial agent (biocide) can suppress the growth of bacteria on the surfaces of products when conditions exist where growth can occur	
4	Feature	Improved Strain Relief boot with Soft latch-cover design for easy depression	
5		Backward compatible for easy integration with any network component that uses a RJ45 connection	
6	Length	1 / 2 / 3 / 5 Meter & Customized length	

7	Connectors	High Grade 50 μ gold plated RJ45 Connectors	
8	Conductor Material	Stranded Bare Copper	
9	Operating Temperature Range	-10 °C to +60°C	
10	Storage Temperature Range:	-20 °C to +70°C	
11	Installation Temperature:	0 °C to +50°C	
12	Sheath Material	LSZH	
13	Cable Diameter	5.9 \pm 0.5 mm	
14	Electrical Specification:	Conductor DC Resistance: 14 Ω / 100m	
15		Resistance Unbalance: 50m Ω	
16		Impedance: 100 Ω \pm 15%	
17	Performance	Patch Cords which will give guaranteed higher bandwidth will be preferred.	
18	Regulatory Compliances	OEM should be an ISO9001, ISO 14001 and ISO 45001 should have its Manufacturing units, Components and Finished Goods Warehouse in India. All Related documents to be submitted.	
		Shall comply to ISO 22196-2011, IEC 71034-2, IEC 60754-2 Standard	
		OEM offered must be in India / SAARC for at-least 10 years or more. Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	
		The Proposed OEM should be a member of BICSI and should have a CDCP and a PMI-PMP / RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	

Technical Specification of Cat6 Field Mount Plug for CCTV

S.No.	Parameter	Specification	Complied (Yes/No)
1	Type	Category 6 Field Terminate RJ45 Plug	
2	Standards	Cat6 Field Mount Plug complies to Complies to ISO/IEC and ANSI/TIA-568.2-D for connectivity an IP-enabled IoT devices / PoE enabled devices and support high-speed applications like Wi-Fi and Video cameras	
3	Termination	Developed under MPTL and designed for use on Solid cable assemblies and strand conductors of sizes from AWG 23 through AWG 26	
4	Housing Material	Polycarbonate (PC), UL94V-0 rated	
5	Plug Contact	0.35mm phosphor bronze	
6	Contact Area	Gold over nickel plating	
7	IDC Contact	0.4mm phosphor bronze, Sn over nickel plating	
8	Durability (IDC Life)	1000 Mating cycle and 5 termination cycle	
9	Operating Temperature Range	-40 °C to +70°C	
	Storage Temperature Range :	-40 °C to +75°C	
	Operating Humidity:	10% to 90% PH	
10	Electrical Performance	Current Rating: 1.5 Amps (max)	
		Insulation Resistance: 500 M Ω @ 500VDC	
		DC Resistance: \leq 0.1 Ω	

11	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of CAT6 Face Plate (1,2 & 4 Port)

S.No.	Parameter	Specification	Complied (Yes/No)
1	Type	UK Style with Built-in Dust Covers / Shutters on Face Plate for closing ports to prevent from dust entry	
2	Material	Manufactured by incorporating an antibacterial agent (biocide) can suppress the growth of bacteria on the surfaces of products when conditions exist where growth can occur.	
3	Acceptability	Should be able to accept Cat6A, Cat6 and Cat5e information outlets, Modules, Keystones and Adaptors to suit all installation requirements	
4	Approvals	UL 94V-0	
5	No. of plates	2 Plates/ Pieces Face Plate for better aesthetic look	
6	Mounting screws	Include mounting screws and Label Holders with Plastic covers	
7	Available	Single/Dual/Quad network faceplate	
8	Dimensions	(H x W x D) 86 x 86 x 14.42 mm	
9	Regulatory Compliances	All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only who is a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
		Compliant to ISO 22196-2011 and RoHS 2 Standards	
		OEM should be an ISO9001, ISO 14001 and ISO 45001 should have its Manufacturing units, Components and Finished Goods Warehouse & R&D labs in India. All Related documents to be submitted.	

Technical Specification of Core Switch

S.No.	Parameter	Specification	Complied (Yes/No)
1	Port Density	24 x 100/1000 BaseX, SFP and 4 x 1/10G SFP+	
		4 x 10/25G SFP28	
2	Power Supply	Redundant Hot Swappable Power Supply - AC/DC	
3	Virtual Chassis/ Stacking Option	Upto 8 Switches or more with 2 x 100G QSFP28 Virtual Chassis/Stacking ports per Switch	
4	RAM	4 GB or better	
5	Flash and Buffer	16 GB or better and 32MB Packet Buffer	

S.No.	Parameter	Specification	Complied (Yes/No)
6	Switching Capacity and forwarding Rate	700 Gbps or better and 500 Mpps or better	
7	Macsec Support and MTBF	Macsec Support: All SFP ports should be macsec capable MTBF: 138,559 h	
8	MAC Address	64K	
9	Routes	IPv4 - 144k or better IPv6 - 72k or better	
10	Quality of Service	Support for Egress rate limiting, eight egress queues per port, IEEE 802.1Q, 802.3x, DiffServ, Jumbo frame	
11	Protocol Support	IGMP Snooping V1, V2, V3, MLD, PIM-SM/PIM-SSM/PIM-DM/PIM-Bidirectional, DVMRP, IPv4 & v2, RIPv2, OSPFv3, RIP, BGPv4, MP-BGP, GRE, IS-IS, ITU-T G.8032, IEEE 802.1s, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP), Ipv4/Ipv6, DHCP Option 82, BPDU, STP Root Guard, SIP detection, SPB-M or MPLS, IEEE 802.1ae, MIB, NTP, Built-in CPU protection against malicious attacks, The Switch Should have 1+N redundant supervisor manager in Virtual chassis with In-Service Software Upgrade (ISSU), VXLAN, ARP Poisoning detection, Policy based routing (PBR), SDN support through Restful API and openflow 1.3.1	
12	Management	SNMP V1, V2, V3, Web GUI, CLI, USB or equivalent from approved make list memory card, IPv6 management feature on open standards, IEEE802.1ag, TDM or equivalent from approved make list standards, Smart continuous switching technology	
13	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS/ TACACS+, SSL, SSH, port mirroring, NTP, IEEE 1588, AES, Syslog, MD5, LLDP-MED, BPDU Blocking, BFD, Unified management, control and fabric-mesh virtual chassis technology, Autosensing IEEE 802.1X multi-client, multi-VLAN support for bridging and SPBM/VXLAN services, MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks	
14	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ITU-T G.8032 ring resilience/ring protection, VRRPv2, MVRP, VRF and Virtual Network Profiles (VNP), Software-controlled VXLAN hardware VTEP gateway	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS	
		US UL 60950, CSA22.2	
		FIPS 140-2, EAL2 & NDcPP Certified	
		EN 60825-1/2 Laser	
17	SFP	SFP should be of same make as switch.	

S.No.	Parameter	Specification	Complied (Yes/No)
18		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image. The Switch should be EAL2/NDPP certified	
19		Toll free number for support in India	

Technical Specification of 24 Port POE Access Switch

S.No.	Parameters	Minimum specification	Complied (Yes/No)
1	Port Density	24 X 1G RJ-45 Ports with 180W power budget 2 x 1G/10G SFP+ Ports and 2 x 1G SFP/Base-T Combo Ports	
2	Power Supply	Internal Power Supply	
3	Virtual Chassis/ Stacking Option	Upto 4 Switches or more	
4	RAM	1 GB or better	
5	Flash	1 GB or better	
6	Switching Capacity and forwarding Rate	92 Gbps or better and 68 Mpps or better	
7	Latency & MTBF	Latency: < 4 μ s MTBF: 2595 k hours	
8	Layer 2 Features	Mac Address: 16K or more VLAN: 4K or more System Policies: 1.5K or more Max Jumbo Frame: 9216 bytes Multicast Group: up to 1000	
10	Quality of Service	Auto QoS for switch management traffic, Policy-based QoS, Traffic Prioritization, Priority Queues: Eight hardware-based queues per port, SPQ, WRR	
11	Protocol Support	Static Routing, MSTP, RSTP, PVST+, IPv6 Tunneling, LACP, LAG, IGMPv3, DHCP, DHCP82, DHCP Relay for IPv4/IPv6, Multiple microcode image support with fallback recovery, ARP, SDN support through Restful API and openflow 1.3.1	
12	Management	Loopback IP address support for management per service, Policy- and port-based mirroring, Remote port mirroring, sFlow v5 and Remote Monitoring (RMON), Unidirectional Link Detection (UDLD), Digital Diagnostic Monitoring (DDM), LLDP-MED, NTP, MVRP, SNMP, sflow or equivalent from approved make list	
13	Security	Dynamic change of authentication (CoA), MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks, Web based Authentication, Autosensing IEEE 802.1X multi-client, multi-VLAN support, RFC 1321 MD5, RFC 2284 PPP EAP, RFC 1826/1827/4303/4305 Encapsulating Payload (ESP) and crypto algorithms, RFC 2104 HMAC Message Authentication, Built-in CPU protection against malicious attacks	

S.No.	Parameters	Minimum specification	Complied (Yes/No)
14	Resiliency	Unified management, control and virtual chassis technology, Virtual Chassis 1+N redundant supervisor manager, Virtual Chassis In-Service Software Upgrade (ISSU), Smart continuous switching technology, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP) and static LAG groups across modules	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS, WEEE	
		US UL 60950, CSA22.2	
		FIPS 140-2	
		EN 60825-1/2 Laser, IEC 62368-1	
17	SFP	SFP should be of same make as switch.	
18		The Switch shall work with on-premises and cloud-based NMS without change in hardware / software / OS Image.	

Technical Specification of 08 Port PoE Industrial Grade Switch

S.No.	Parameter	Specification	Complied (Yes/No)
1	Port Density & Redundancy	4 x 1G RJ-45 PoE+ Ports (30W) 4 x 1G RJ-45 HPoE Ports (60W) 4 x 1G SFP Switch should be supplied with 2x1G Single Mode Industrial SFP of same OEM from day one and have Power budget of 240W with perpetual PoE feature.	
2	PoE Capability	Fixed-configuration hardened fan-less compact DIN-mount chassis with eight 10/100/1000 Base-T PoE+ ports, four of which can support 60W PoE, and four 100/1000 Base-X SFP ports.	
3	Stacking Option	Minimum 4 units in a stack/Virtual stack or better	
4	RAM and Flash	Minimum 1 GB RAM and 1 GB FLASH	
5	Switching Capacity and forwarding Rate	Should support minimum non-blocking switching capacity of 24 Gbps and forwarding rate 17 Mpps	
6	Macsec and 1588v2 Capable Ports, Alarm Relays	Macsec: 12 Ports 1588v2: 12 Ports Alarm Relays: 1 in, 1 out MTBF: 14,21,933 (Hours)	
7	Mac Address, IPv4 Routes and VLAN	<ul style="list-style-type: none"> Total number of MAC addresses: 16,000 Total number of IPv4 routes: 128 Number of VLANs: 4,000 	
8	Quality of Service	Support for Egress rate limiting, eight egress queues per port, Voice VLAN, DSCP for IP-based QoS, Differentiated services architecture, IEEE 802.1p Class of Service with strict and weighted round Robin scheduling. 32-bit IPv4/128-bit IPv6 non-contiguous mask classification	

S.No.	Parameter	Specification	Complied (Yes/No)
9	Protocol Support	IGMP Snooping V1, V2, V3, ITU-T G.8032, IEEE 802.1s, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP), DHCP Option 82, BPDU, STP Root Guard, Unified management, control and virtual chassis technology, Virtual Chassis 1+N redundant supervisor manager, Smart continuous switching technology, VRRP, PVST+, IEEE protocol auto-discovery	
10	Management	SNMP V1, V2, V3, Web GUI, CLI, USB or equivalent from approved make list memory card, IP v6 management feature on open standards, IEEE802.1ag, TDM or equivalent from approved make list standards, Port Mapping, HA VLAN for L2 Cluster	
11	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS/ TACACS+, SSH with PKI, port mirroring, NTP, IEEE 1588v2, MACSEC on all ports, MD5, AES Encryption, Built-in CPU protection against malicious attacks, PPP EAP	
12	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ring resilience/ring protection	
13	Power Supply	Fan less - Redundant Hot Swappable Power Supply - AC/DC	
14	Enclosure Rating	IP30 Industrial Grade Rating	
15	Operating Temperature	Minus 40° C to 74° C (-40° F to 165° F)	
16	Safety Certifications	UL 508, UL 61010 EN 50021, EN 55032 ISA 12.12.01, CSA22.2/213 IEC 60255-21-2, IEC 60255-21-1 RoHS standards NEMA -TS2 IEC 60255-21-2 (mechanical shock) IEC 60255-21-1 (vibration) EN 50121-4 EN 50155:2017 IEEE 1613, Section 4 to 8 IEC 61850-3 TEC Certified	
		Surge protection of 6KV on all copper ports	

Technical Specification of 04 Port PoE Industrial Grade Switch

S.No.	Parameter	Specification	Complied (Yes/No)
1	Port Density & Redundancy	2 x 1G RJ-45 PoE+ Ports (30W) 2 x 1G RJ-45 HPoE Ports (60W) 2 x 1G SFP Switch should be supplied with 2x1G Single Mode Industrial SFP of same OEM from day one.	
2	PoE Capability	Fixed-configuration hardened fan-less compact DIN-mount chassis with four 10/100/1000 Base-T PoE+ ports, two of which can support 60W PoE, and two 100/1000 Base-X SFP ports.	
3	Stacking Option	Minimum 4 units in a stack/Virtual stack or better	
4	RAM and Flash	Minimum 1 GB RAM and 1 GB FLASH	
5	Switching Capacity and forwarding Rate	Should support minimum non-blocking switching capacity of 12 Gbps and forwarding rate 8 Mpps	
6	Macsec and 1588v2 Capable Ports, Alarm Relays	Macsec:6 Ports 1588v2: 6 Ports Alarm Relays: 1 in, 1 out MTBF: 14,52,904 (Hours)	
7	Mac Address, IPv4 Routes and VLAN	<ul style="list-style-type: none"> Total number of MAC addresses: 16,000 Total number of IPv4 routes: 128 Number of VLANs: 4,000 	
8	Quality of Service	Support for Egress rate limiting, Eight egress queues per port, Voice VLAN, DSCP for IP-based QoS, Differentiated services architecture, IEEE 802.1p Class of Service with strict and weighted round Robin scheduling.32-bit IPv4/128-bit IPv6 non-contiguous mask classification	
9	Protocol Support	IGMP Snooping V1, V2, V3, , ITU-T G.8032, IEEE 802.1s, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP), DHCP Option 82, BPDU, STP Root Guard, Unified management, control and virtual chassis technology ,Virtual Chassis 1+N redundant supervisor manager, Smart continuous switching technology, VRRP, PVST+, IEEE protocol auto-discovery	
10	Management	SNMP V1, V2, V3, Web GUI, CLI, USB or equivalent from approved make list memory card, IP v6 management feature on open standards, IEEE802.1ag, TDM or equivalent from approved make list standards, Port Mapping, HA VLAN for L2 Cluster	
11	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS/ TACACS+, SSH with PKI, port mirroring, NTP, IEEE 1588v2, MACSEC on all ports, MD5, AES Encryption, Built-in CPU protection against malicious attacks, PPP EAP	
12	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ring resilience/ring protection	

S.No.	Parameter	Specification	Complied (Yes/No)
13	Power Supply	Fan less - Redundant Hot Swappable Power Supply - AC/DC	
14	Enclosure Rating	IP30 Industrial Grade Rating	
15	Operating Temperature	Minus 40° C to 74° C (-40° F to 165° F)	
16	Safety Certifications	UL 508, UL 61010 EN 50021, EN 55032 ISA 12.12.01, CSA22.2/213 IEC 60255-21-2, IEC 60255-21-1 RoHS standards NEMA -TS2 IEC 60255-21-2 (mechanical shock) IEC 60255-21-1 (vibration) EN 50121-4 EN 50155:2017 IEEE 1613, Section 4 to 8 IEC 61850-3 TEC Certified Surge protection of 6KV on all copper ports	

Technical Specification of Dome camera

S.No.	Technical Specification		Complied (Yes/No)
1	Image sensor	1/2.8" Progressive scan CMOS sensor	
2	Compression	H.265, H.264 High & Main profiles; and MJPEG	
3	Resolution	Minimum 2 Mega Pixel; 1920X1080 @ 25/30FPS	
4	Lens	3.4-10.5mm, Varifocal FOV 81° (Horizontal)	
5	Auto Iris type	P-iris	
6	Shutter speed	1/32,000 sec ~ 1/5 sec	
7	Wide Dynamic Range	100db as per IEC 62676-part 5 Standard	
8	Minimum Illumination	Color- 0.25 Lux, 0Lux with IR ON	
9	IR Illumination	Inbuilt 850nm Adaptive IR 30-meter range	
10	Pan/Tilt/Zoom Functionalities		
11	Video Stream and Compression	Camera shall support smart compression and shall support configurable three simultaneous streams.	
12	Signal to Noise Ratio	50dB	
13	camera features	white balance, image adjustment (brightness, contrast, saturation, sharpness) defog, BLC, HLC, Privacy mask, flip mode, mirror mode	
14	Camera Security	Password protected, HTTPS using TLS 1.2, 802.1x network authentication with EAP/TLS, Digest Authentication, IP Filtering, AES encryption with 256 bit keys, 2048bit RSA key pairs, X.509 v3 digital certificates with SHA256, digital certificates on the camera both self-signed or uploaded from external PKI	
15	Edge based analytics	Simple Motion Detection, Camera Tampering, and Audio Detection. Support AI Based analytics with person and vehicle classification. Object in area, line crossing, loitering, directional violation.	

S.No.	Technical Specification		Complied (Yes/No)
16	Connectivity / Power	IEEE 802.3af PoE	
17	Operating Temperature	-10°C ~ 60°C	
18	Edge Storage	Camera shall support 1 TB SD CARD.	
19	camera Protocols	802.1X, ARP, Bonjour, CIFS/SMB, DDNS, DHCP, DNS, FTP, HTTP, HTTPS, ICMP, IGMPv3, IPv4, IPv6, NTP, PPPoE, QoS (CoS/DSCP), RTSP/RTP/RTCP, SMTP, SNMP, SSL, TCP/IP, TLS 1.2, UDP, UPnP	
20	Environmental Protection	IP66 as per IEC/EN 60529	
21	Vandal Proof	IK10 as per IEC/EN 62262	
22	ONVIF Compliance	ONVIF Profile S, Profile M, Profile G conformant & Profile T conformant The Camera to be provided by OEM should not be complying to GB28181, GB/T28181-2011 standards and there should be no option to activate or deactivate GB/T 28181 standards in the camera web page/Settings.	
23	Certifications	UL/cUL Listed, UL/IEC/EN 62368-1, 60950-22, CE, FCC	
24	NDA Compliance	Camera shall be compliant to NDA for cyber security	
25	country of origin	Camera country of origin shall be non-chinese	
26	MAF	OEM to submit MAF for the Products to Authorised Partner/ System integrator	
28	Warranty	3 Years	

Technical Specification of Bullet camera

S.No.	Technical Specification		Complied (Yes/No)
1	Image sensor	1/2.8" Progressive scan CMOS sensor	
2	Compression	H.265, H.264 High & Main profiles; and MJPEG	
3	Resolution	Minimum 2 Mega Pixel; 1920X1080 @ 25/30FPS	
4	Lens	3.5-9mm, Autofocus motorized remote zoom lens	
5	Auto Iris type	P-iris (same as dome camera)	
6	Shutter speed	1/32,000 sec ~ 1/5 sec	
7	Wide Dynamic Range	100db as per IEC 62676 part 5 Standard	
8	Minimum Illumination	Color- 0.25 Lux, 0Lux with IR ON	
9	IR Illumination	Inbuilt 850nm Adaptive IR 50-meter range	
10	Pan/Tilt/Zoom Functionalities		
11	Video Stream and Compression	Camera shall support smart compression and shall support configurable three simultaneous streams.	
12	Signal to Noise Ratio	50dB	
13	camera features	white balance, image adjustment (brightness, contrast, saturation, sharpness) defog, BLC, HLC, Privacy mask, flip mode, mirror mode	

S.No.	Technical Specification		Complied (Yes/No)
15	Camera Security	Password protected, HTTPS using TLS 1.2, 802.1x network authentication with EAP/TLS, Digest Authentication, IP Filtering, AES encryption with 256-bit keys, 2048bit RSA key pairs, X.509 v3 digital certificates with SHA256, digital certificates on the camera both self-signed or uploaded from external PKI	
16	Edge based analytics	Simple Motion Detection, Camera Tampering, and Audio Detection. (Support AI Based analytics with person and vehicle classification. Object in area, line crossing, loitering, directional violation)	
17	Connectivity / Power	IEEE 802.3af PoE	
18	Operating Temperature	-10°C ~ 60°C	
19	Edge Storage	Camera shall support 1 TB SD CARD.	
20	camera Protocols	802.1X, ARP, Bonjour, CIFS/SMB, DDNS, DHCP, DNS, FTP, HTTP, HTTPS, ICMP, IGMPv3, IPv4, IPv6, NTP, PPPoE, QoS (CoS/DSCP),RTSP/RTP/RTCP, SMTP, SNMP, SSL, TCP/IP, TLS 1.2, UDP, UPnP	
21	Environmental Protection	IP66 as per IEC/EN 60529	
22	Vandal Proof	IK10 as per IEC/EN 62262	
23	ONVIF Compliance	ONVIF Profile S, Profile M, Profile G conformant & Profile T conformant. The Camera to be provided by OEM should not be complying with GB28181, GB/T28181-2011 standards and there should be no option to activate or deactivate GB/T 28181 standards in the camera web page/ Settings.	
24	Certifications	UL/cUL Listed, UL/IEC/EN 62368-1, 60950-22, CE, FCC	
25	NDA Compliance	Camera shall be compliant to NDA for cyber security	
26	country of origin	Camera country of origin shall be non-chinese	
27	MAF	OEM to submit MAF for the Products to Authorised Partner/ System integrator	
28	Warranty	3 Years	

Technical Specification of PTZ camera

S.No.	Technical Specification		Complied (Yes/No)
1	Image sensor	Progressive 1/2.8-inch type CMOS sensor	
2	Resolution	Minimum 2 Mega Pixel ; 1920X1080 @60fps	
3	Lens	4.3~4.5- 129~135 mm Autofocus motorized remote zoom lens	
4	Iris Control	Auto Iris with Manual Override	
5	Minimum Illumination	Color- 0.1 Lux , B/W -0.05lux; 0Lux with IR ON	
6	FOV (H)	59.8° (wide) ~ 2.34° (tele)	
7	IR Illumination	Integrated IR 150 m or better	
8	Zoom	30X optical zoom and 12x Digital zoom	
9	Signal to Noise Ratio	>=50db	

S.No.	Technical Specification		Complied (Yes/No)
10	Compression	H.265, H.264 High & Main profiles; and MJPEG	
11	Wide Dynamic Range	120dB	
12	Window Masking	16	
13	Camera features	Backlight compensation, Automatic gain control, Digital Image Stabilization, Day/Night	
14	Presets, tours	256 presets, 16 tours	
15	Video Stream	Up to three simultaneous streams, the second and the third stream are variable based on the setup of the primary stream	
16	Smart Compression	Yes, to lower bandwidth and storage requirements by up to 70%, CBR, CVBR	
17	Shutter speed	1/4 ~ 1/30,000 sec	
18	Edge based analytics	Motion detection and camera sabotage	
19	Audio input and output	Line level/external microphone input; 1Vp-p maximum signal level	
20	Alarm input	Two alarm input & Two alarm output	
21	Pan Range and preset speed	360° continuous pan rotation,300°/sec	
22	Tilt Range and preset speed	+30° to -90° degrees, 145°/sec	
23	Streaming	Camera should support unicast and multicast streams.	
24	Edge Storage	camera shall support 2TB SD Card	
25	Ethernet, Network protocols	TCP/IP, UDP/IP (Unicast, Multicast IGMP), ARP, ICMP, UPnP, DNS, DHCP, RTP, RTSP, NTP, IPv4, IPv6, SNMP v2c/v3, QoS, HTTP, HTTPS, SSH, SSL, SMTP, FTP, and 802.1x (EAP)	
26	Housing	Aluminium	
27	Power requirement	PoE+/48 VDC/24 VAC	
28	Security access	Password protected, HTTPS using TLS 1.2, 802.1x network authentication with EAP/TLS, Digest Authentication, IP Filtering, AES encryption with 256-bit keys,2048bit RSA key pairs, X.509 v3 digital certificates with SHA256, digital certificates on the camera both self-signed or uploaded from external PKI	
29	Environmental Protection	IP66 and NEMA 4X	
30	Vandal Protection	Housing IK10, Glass IK07	
31	heater and blower	inbuilt in Camera	
32	Operating Temperature with IR	-40 to 60° C Degrees.	
33	Operating Humidity	0 to 90% RH (condensing)	
34	ONVIF Compliance	ONVIF Profile S, Profile M, Profile G conformant & Profile T conformant The Camera to be provided by OEM should not be complying to GB28181, GB/T28181-2011 standards and there should be no option to activate or deactivate GB/T 28181 standards in the camera web page/Settings.	
35	Regulatory Approvals	UL/cUL Listed, CE, FCC	
36	NDAA Compliance	Camera shall be compliant to NDAA for cyber security	
37	Country of origin	Camera country of origin shall be non- Chinese	

Technical Specification of Multi-Sensor Camera

S.No	Technical Specification		Complied (Yes/No)
1	Image sensor	1/2.5" progressive scan CMOS	
2	Resolution	3840x2160x4	
3	Lens	4mmF1.8-101°	
4	Electronic Shutter Control	Automatic, Manual (1/8 to 1/8000 sec)	
5	Minimum Illumination	Colour- 0.02 Lux, Mono - 0.04 Mono, 0 lux with IR illuminator	
6	IRIS Control	Fixed	
7	Compression	H.264 Pelco Smart Compression, H.265 Pelco Smart Compression, Motion JPEG	
8	Wide Dynamic Range	100 dB	
9	3D Noise Reduction Filter	Available	
10	IR Illuminator	30 Mtr	
11	Day/Night Camera	Auto day/night configuration.	
12	Edge based Analytics	CNN based Analytics which can classify Person and Vehicle (sub-types: Car, Truck, Bicycle, Motorcycle, Bus), Object Loitering, Directional Motion, Object Appears in Area, Object Stops in Area, Object leave Area,	
13	Window Blanking	upto 64 Zones	
14	Backlight Compensation	Yes	
15	Advance Compression	Yes, to lower bandwidth and storage requirements by up to 70%.	
16	Pan Tilt Adjustment	PAN: +/-120 ° (depending on position of image sensors), Tilt: +7° to 96 ° from horizon, Azimuth: +/-180 °	
17	Tamper detection	ON/OFF	
18	Audio	Line level input and output, G.711 PCM 8 kHz	
19	Streaming	Multi-stream H.264, Multi-stream H.265, Motion JPEG, Pelco Smart Compression	
20	Motion Detection	Selectable sensitivity and threshold	
21	Security	Password protection, HTTPS encryption, digest authentication, WS authentication, user access log, 802.1x port-based authentication, TLS1.3, FIPS140-2 Level 1	
22	Alarm input	One alarm input & One alarm output.	
23	Edge Storage	MicroSD/micro SDHC /micro SDXC slot - video speed class card required. Class V10 or better recommended.	
24	Ethernet, Network protocols	Gigabit Ethernet, 100BASE-TX, 1000BASE-TX	
25	Housing	Aluminium, Cast, Anodized and Powder Coated, Pantone 427C	
26	Power requirement	24VDC±10%;24VACrms±10%,50or60Hz, IEEE 802.3at Type 2	
27	Protocol	Pv4, IPv6, HTTP, HTTPS, SOAP, DNS, NPT, RTSP, RTCP, RTP, TCP, UDP, IGMPv2, ICMP, DHCP, Zeroconf, ARP, HSTS	
28	Streaming Protocol	RTP/UDP, RTP/UDP multicast, RTP/RTSP/TCP, RTP/RTSP/HTTP/TCP, RTP/RTSP/HTTPS/TCP, HTTP	
29	Environmental Protection	IP66 Weather Rating, NEMA 4X, NEMA TS-2	
30	Vandal Proof Certification	IK10 Impact Rating,	
31	Operating Temperature	-40°Cto+60°C(-40°Fto140°F)	
32	Operating Humidity	0 - 95% non-condensing	

S.No	Technical Specification		Complied (Yes/No)
33	Shock and Vibration	IEC 60068 2-6 IEC 60068 2-27	
34	ONVIF Compliance	ONVIF Profile S, Profile G , ONVIF T & ONVIF M Compliant	
35	Regulatory Approvals	UL/CSA/IEC 60950-22, FDOT/NEMA TS2, 150 mph Wind Speed rating	
36	Electromagnetic Emission	FCC Part 15 Subpart B Class B, IC ICES-003 Class B, EN 55032 Class B, EN 61000-6-3, EN 61000-3-2, EN 61000-3-3	
37	Electromagnetic immunity	EN 55024, EN 61000-6-1, EN 50121-4 (when used with FERR-1001 on aux power)	
38	Directives	RoHS, Reach (SVHC), WEEE	

Technical Specification of Video management Server

S.No.	Technical Specification		Complied (Yes/No)
1	Form Factor	Rack Server	
2	Processor	Intel® Xeon® Silver 4310	
3	Memory	16 GB DDR4 ECC	
4	Operating system	Microsoft Windows 10 IoT Enterprise 64-bit (LTSC)	
5	OS DRIVE	2x M.2 SSDs 240 GB (RAID 1)	
6	USB 2.0	2 Ports	
7	USB 3.0	2 Ports	
8	Graphic Card	NVIDIA Quadro P1000 (4 GB memory)	
9	Ethernet Port	Gigabit Ethernet (1000Base-T) ports (2x), dedicated iDRAC port	
10	Dedicated iDRAC	Support IPv4 and IPv6	
11	Power supply	Dual Hot Swappable 750 W	
12	Recording Throughput	Up to 450 Mbps	
13	Dedicated iDRAC	Support IPv4 and IPv6	
14	Raw Storage Support	UPTO 144 TB	
15	HDD	8 SATA HDD (Support upto 18 TB each)	
16	RAID	RAID 5/6	

Technical Specification of Video Management Software

S.No.	Technical Specification	Complied (Yes/No)
1	The Video Management System (VMS) shall be a Microsoft Windows®-based video management and surveillance system	
2	Maintain the database of cameras and recording devices and to provide a web-based administrative portal to manage the video surveillance system	
3	The IP video management system shall record video and audio streams from IP cameras	
4	The system shall support recording schedules, including the ability to record based on motion, analytic, and alarm events	

S.No.	Technical Specification	Complied (Yes/No)
5	The IP video management system shall be capable of continuous scheduled alarm/event and motion recording. Pre- and post- alarm recording shall also be available and shall be fully programmable on a per channel basis	
6	The IP Video Management System shall support recording of primary or secondary streams, individually or simultaneously. The server application can be configured to record a stream in unicast or multicast	
7	The IP Video Management System shall support video bookmarking, such that users can identify and recall important moments in recorded video based on the bookmark name or notes that are associated with it	
8	The system shall comply to ONVIF profile S, G, T & M, and shall have valid ONVIF certificate.	
9	The system shall support aggregation by a higher-level environment, allowing the IP video management system to belong to a confederation of servers	
10	The IP VMS shall support Lightweight Directory Access Protocol (LDAP) to authenticate users	
11	The IP video management system shall allow archival of video data to external network locations or NAS devices over a network connection. The archival schedule shall be either automatic at user-defined intervals or manually executed	
12	Client Workstation shall support tab shall support up to 64 cameras in a 8 x 8 layout	
13	An operator with appropriate permissions shall be able to send a saved workspace to other clients, causing their system to launch the saved workspace	
14	VMS shall support Collaborative Tabs: an operator with appropriate permissions can view a designated collaborative tab so that multiple operators at different stations can see the exact same content and can make changes to live and playback video on this tab that other operators can see in real time.	
15	The Client application shall enable synchronized playback of up to nine (9) streams simultaneously in one tab	
16	System shall support functionality with FIPS-validated cryptographic modules, FIPS 140-3	
17	VMS shall have the the ability to reduce the frame rate of previously recorded video after a specified number of days, resulting in increased retention time and storage cost savings	
18	Camera and VMS shall be of same make for seamless integration	

Technical Specification of Professional Display

S.No.	Technical Specification		Complied (Yes/No)
1	SCREEN SIZE	65" or 163 cm diagonal	
2	ASPECT RATIO	16:09	
3	RESOLUTION	UHD (3840*2160)	
4	VIEWING ANGLE (HORIZONTAL/ VERTICAL)	178°/178° (H/V)	
5	AV	Yes	
6	USB INPUT (2.0 SUPPORT)	2 x (USB2.0)	
7	HDMI INPUT	3 x (HDMI 2.0)	
8	OS	Android	
9	RJ-45	Yes	
10	USB DEVICE SUPPORT	Yes	

11	AUDIO OUTPUT POWER (RMS)	20 W (10+10 W)	
12	BLUETOOTH	Yes	
13	INBULIT WIFI	Yes	
14	Certification	BIS /ROHS/CE/FCC	

Technical Specification of Workstation/Client PC

S.No.	Technical Specification		Complied (Yes/No)
1	Processor	Intel i7-8700k or better	
2	RAM	16GB	
3	OS	Genuine Microsoft Windows 10 Enterprise/IOT 64 Bit	
4	Graphic Card	In-built Processor Graphics (GPU): Intel HD Graphics 630 or Intel Q470 Processor or better	
5	Internal storage	480 GB SSD/SATA	
6	Ethernet Port	01 Gigabit LAN	
7	Monitor Support	supporting 2 Monitors	
8	Ethernet Port	01 Gigabit LAN	
9	Audio Port	IN & OUT	
10	Accessories	Keyboard, Mouse & Associated Cables	

SCOPE OF WORK

Planning, Supplying, Installing, Testing & Commissioning of the CCTV Surveillance system shall be provided for the security system in and outside the building and around the campus as per the following:

(A) CCTV & SURVEILLANCE SYSTEM

- i. Minimum 1 number Dome Camera shall be provided at each Lift Lobby in each floor.
- ii. Minimum 1 number Dome Camera shall be provided at all staircase entrance, corridor in each floor.
- iii. Minimum 1 number Dome camera shall be provided in Server Room, BMS room etc.
- iv. Minimum 2 numbers Bullet cameras shall be provided at vehicle entrance/ vehicle exits at each gate.
- v. Minimum 2 numbers Bullet cameras shall be provided at each Entrance & Terrace floor to cover all the areas.
- vi. Cameras shall be provided in & outside various buildings such as Indoor Stadium, Outdoor Stadium & Hostel Block, Substation room, AC plant room, Fire fighting room, parking etc.
- vii. Minimum 4 numbers PTZ cameras shall be provided at suitable places around the periphery of each buildings to cover the entire campus of the building.

The hardware required for the system including Servers, NVR, Workstations, Monitors, CAT-6A Patch Cable to connect the camera to nearest POE enabled LAN Network switches, Cat-6 A armoured copper Cables, connectors, conduits, power supplies etc. will be in the vendor's scope. Details of specification of IP back bone is given in the subhead of Local area network. Backbone upto core switch and rack in CCTV control room is taken in the scope of LAN subhead. The complete LAN networking, for the CCTV should be separate and exclusively for CCTV system only and not mixed with other LAN system. It will be the responsibility of the vendor/bidder to make the entire system fully functional as per the specifications. Vendor/bidder shall consider all the equipment's, devices required to make the system functional if not mentioned here with.

The Vendor shall supply and install an IP based Camera CCTV system with the objective to provide High degree of Electronic surveillance system. It is also essential to have recorded images to be stored at least for 30 days @ 2MP 30fps of all critical areas as to facilitate investigations of a reported case. Bidder must offer the System with 30 days of Storage @ 2MP 30fps in RAID-5 with 20% Buffer capacity. (Bidder must calculate the storage capacity considering 1.7TB per camera for 30 days).

Building's Main Entry & Exit, Critical Areas, all Lift Lobbies, staircase entrance corridors of all floors, Reception area, Ground floor car parking area i/c driveway, server room, BMS room, Terrace floor & campus of the building etc. shall be fully covered along with any other critical area as per the requirement of client as a minimum.

The bidder is free to suggest/consider any other critical area under surveillance.

The Camera should have ONVIF Profile S& G Compliance. All equipments and materials used shall be standard components thoroughly tested and proven in actual use, that are regularly manufactured and used in the system.

Bidder shall calculate the camera quantity as per the scope of work and full coverage requirement.

For Camera Monitoring and Control, minimum 55inch Full HD Monitor shall be considered. All the cameras shall be live on using multiple monitors. One monitor shall have not more than 36 camera 6x6 Grid. Minimum Two Monitors can be used in on one work station in Dual Monitor Mode. Minimum 05 concurrent work station license shall be offered and number of Workstation and Monitors shall be decided by the Engineer-in-charge as per actual site requirements.

(B) VIDEO WALL:

Supply installation testing & commissioning of 2x2 Video Wall panels total diagonal size of 110" VIDEO WALL Ultra HD LED Display for Monitoring Multifaceted UHD video wall solution based on daisy chain through the use of Display Port, Ultra-narrow 3.5mm bezel-to-bezel. Anti-glare panel (haze 44%), with reliable 24/7 operation. Including Mounting brackets and video wall controller.

IP CCTV BOQ:

S.No.	Item Description	Unit
	<u>CCTV SYSTEM</u>	
1	Supply, Installation, Testing & Commissioning of armored 06 Core Singlemode (OS2) 9/125 Fiber Cable, ITU G.652.D, G.657A1, Outdoor Corrugated ECCS Armor, HDPE (UV) Sheathing, Theoxotropic gel filled OFC cable with 2 Nos steel wire embedded in side sheathing as strengthening member for switch connectivity. Cable should be ROHS compliant and as per ANSI/TIA-568.3-D, Telcordia GR-20, IEC 60794-2/60794-3-10, ISO/IEC 11801, ISO/IEC 24702 complete on surface / recess / in existing pipe / open duct complete etc as required.	Nos.
2	Supply, Installation, Testing & Commissioning of 6F 1U x 19" LIU Loaded with Singlemode OS2 LC Adapters & LC Type LSZH Pigtails should meet IEC 61034-1 ,IEC-60332-1, IEC-60754-1, Insertion loss <= 0.35 dB, Return Loss >= 50, Attenuation: 1310/1550 : 0.3/0.2 dB/KM, Repeatability: <= 0.2DB 1000 times mating cycles along with Splice tray, cable holder and 4 nos of cable entry exist point with rubber gurment along with the LIU, SPCC Powder Coated, 2-Cut Out type, 1U, RoHS Complied, Meets ANSI/TIA 568.3-D. etc complete as required.	Nos.
3	Supply, Installation, Testing & Commissioning of 24F 1U x 19" LIU Loaded with Singlemode OS2 LC Adapters & LC Type LSZH Pigtails should meet IEC 61034-1 ,IEC-60332-1, IEC-60754-1, Insertion loss <= 0.35 dB, Return Loss >= 50, Attenuation: 1310/1550 : 0.3/0.2 dB/KM, Repeatability: <= 0.2DB 1000 times mating cycles along with Splice tray, cable holder and 4 nos of cable entry exist point with rubber gurment along with the LIU, SPCC Powder Coated, 2-Cut Out type, 1U, RoHS Complied, Meets ANSI/TIA 568.3-D. etc complete as required.	Nos.
4	Supply, Installation, Testing & Commissioning of LC-LC 9/125µm OS2 Singlemode Round Cord duplex, LSZH fiber patch cord having a protective layer of metal braiding for LIU to switch connectivity. Patch Cord should have Blue Jacket with 1000-time mating cycle complete etc as required.	Nos.
5	Supply, Installation, Testing & Commissioning of CAT 6 U/UTP LSZH Cable, Flame Rating IEC 60332-1, 23 AWG solid copper conductors in accordance to TIA/EIA 568.2-D (Category 6) & ISO/IEC 11801 2nd ed(Class E), ETL 04-Connector Channel Verified with MTPL, tested @350 Mhz or more, with HDPE insulation of individual conductor and over all Dia of 5.9 ± 0.3 mm with Cross-filler and cable shall not have any kind of Non Metallic Barrier Tape or Metallic Shield inside for Connectivity of Hub room to End Point on surface/ recess/ in existing pipe/ open duct complete etc. as required.	Nos.
6	Supply, Installation, Testing & Commissioning of Category 6 RJ45 Unshielded Modular Jack, Keystone information outlet (I/O) in accordance with ANSI/TIA 568.2-D, IEC 60603-7-4 2nd Edition, ISO/IEC 11801, ROHS Compliant. The I/O should have minimum 750 mating cycle and 200 insertion cycle and ETL 04-Connector Channel Verified with MTPL, tested @ 350Mhz for Data, Voice, & Wi-Fi at Field End complete etc as required.	Nos.
7	Supply, Installation, Testing & Commissioning of Staggrd 24 Port Unshielded, Loaded with Category 6 RJ45 Unshielded Modular Jack Panel, Keystone information outlet (I/O) in accordance with ANSI/TIA 568.2-D, IEC 60603-7-4 2nd Edition, ISO/IEC 11801, ROHS Compliant. The I/O should have minimum 750 mating cycle and 200 insertion cycle and ETL 04-Connector Channel Verified, 1U height, Black with integrated cable support bar, clear label marks and earthing plug for UTP cable termination at rack end complete etc as required for CAT6 cable termination at rack end.	Nos.
8	Supply, Installation, Testing & Commissioning of Category 6 RJ45 Unshielded LSZH Patch Cord as per ANSI/TIA/EIA 568.2-D and ETL 04-Connector Channel Verified, ROHS Compliant, 24AWG Patch Cord, Diameter 5.8 ± 0.03 mm, 1 Meter, Operating Temperature -10 Deg C to +60 Deg C. patch cord 1 Mtr for Data at Rack Side for Switch to Jack Panel Connectivity complete etc as required.	Nos.
9	Supply, Installation, Testing & Commissioning of Category 6 RJ45 Unshielded LSZH Patch Cord as per ANSI/TIA/EIA 568.2-D and ETL 04-Connector Channel Verified, ROHS	Nos.

S.No.	Item Description	Unit
	Compliant, 24AWG Patch Cord, Diameter 5.8 ± 0.03mm, 2 Meter, Operating Temperature -10 Deg C. to +60 Deg C. patch cord 2 Mtr for Data at User Side for I/O to Computer Connectivity complete etc as required.	
10	Supply, Installation, Testing & Commissioning of 1, 2, and 4 Port face plate, British Style with Shutter, 2 Plate system clear finish with transparent labelling, ABS-UL94-V0, ROHS Compliant, in accordance with standards like ANSI/TIA-568.2-D, ISO/IEC 11801:2002 & ISO/IEC 60603-7 white for I/O fixing at user side complete etc as required.	Nos.
11	Supply, Installation, Testing & Commissioning of 9/12U Wall mount (600 mm x 600 mm) Networking rack with fans, 2 cable managers, 2 Nos. of hardware pkts.	Nos.
12	Supply, Installation, Testing & Commissioning of Power Distribution Unit with 1.5-Meter-long cords & 06 Socket of 5/15 Amp.	Nos.
13	Supply, Installation, Testing & Commissioning of 2Mpx IR Fixed lens Dome Camera. (As per Technical specification).	Nos.
14	Supply, Installation, Testing & Commissioning of 2Mp IR Varifocal Bullet Camera. (As per Technical specification).	Nos.
15	Supply Installation Testing and Commissioning of Video Management Server support for 128 Cameras, Rack type server, Operating System Microsoft Windows 10 IoT Enterprise 64-bit (LTSC) Memory 16 GB DDR4 ECC 2x M.2 SSDs 240 GB (RAID 1) Processor Intel® Xeon® Silver 4310 Dell iDRAC Controller iDRAC9 Basic NVIDIA Quadro P1000 (4 GB memory) Video Outputs 4x Mini DisplayPort (DP++) 1.4 2 x Gigabit Ethernet (1000Base-T) ports IP Version IPv4 and IPv6 HDD Slot: 8 SATA HDD (Support upto 16 TB each) Recording Throughput 450Mbps Bandwidth	Nos.
16	Supply Installation Testing and Commissioning of Video Management Software with licenses for all above Camera's, All Cameras shall be of same make *web based client allows viewing and exporting video without installing any software. *Imports users and roles from existing LDAP servers to reduce administrative overhead, and enables single sign-on (SSO) *Capable of listening for ASCII commands *Check on VMS and camera health using SNMP *Supports IPv4 and IPv6 cameras *Enables and supports Risk Management Framework (RMF),incorporates FIPS 140-3 validated cryptographic modules *TLS-based encryption over HTTPS	Lot
17	Supply, Installation, Testing and commissioning of Surveillance Garde 16TB SATA Hard Disk for above VMRs, including fixing accessories and cable termination with required, complete in all respect as per instruction of engineer in-charge. Recording shall be calculated at 2MP, 25fps for 30 days.	Nos.
18	Supply, Installation, Testing and Commissioning of 55" Display Panel having contrast ratio 1200:1, Aspect Ratio: 16:9, Native Resolution : 3,840 X 2, 160 (4K), Brightness : 400 nits, Viewing Angle (H X V): 178 X 178, Surface T treatment : Hard coating (3H) Anti-glare Treatment of the Front Polarizer (Haze 1 % Typ.), Speakers : 10 w x2, Orientation: Landscape & Portrait, Input/Output: HDMI (3), Data Point : RJ45, USB, WIFI, BLUETOOTH, Operation Temperature 0°c to 40°c , Operation Humidity: 10% to 80%, Power Supply: 100-240V~, 50/60Hz, Remote on/off. Source Change, Volume, Generate Reports and Email notifications. Accessories Remote Control, Power Cord, User Guide etc, BIS /ROHS/CE/FCC complete as required.	Nos.
19	Supply, Installation, Testing and Commissioning of 15 Mtr. HDMI Cable.	Nos.
20	Supply, installation, testing & commissioning of Client Workstation as per following specifications: Intel Core i7-8700K or better, 4.2GHz, OS - Genuine Microsoft Microsoft ® Windows 10 Enterprise/IOT 64 Bit, RAM - 16GB, OS - 480 GB SSD/SATA, Graphic Card - In-built Processor Graphics (GPU):Intel® HD Graphics 630 or Intel Q470 Processor, supporting 2 Monitors, 01 LAN 01GBPS, Audio IN & Out, USB3.0, Keyboard and Mouse, associated cables etc complete.	Nos.

S.No.	Item Description	Unit
21	Supply, Installation, Testing & Commissioning of Core Switch with 24 x 1G SFP ports with 4 X10G SFP+ ports and 4 x 10/25G SFP28 with switching capacity of 728 Gbps, forwarding performance of 540 Mpps, dual hot swappable internal power supply, should have Stacking with stacking bandwidth of minimum 200 Gbps. Should support min 4GB internal DRAM, 16GB internal Flash memory, 64K MAC address, 144K IPv4 Routes and 72K IPv6 Routes, MTBF: 195K Hours, should have static routing OSPF, VXLAN, VRF, PIM and VRRP from Day 1. Should support BGPv4 and IS-IS from Day 1. The Switch should be EAL2/NDcPP , FIPS 140-2 certified and should be managed with both On-premise and Cloud based controller without changing it's Software image.	Nos.
22	Supply, Installation, Testing & Commissioning of 24 Port POE Access Switches with switching capacity of 92 Gbps, forwarding performance 68 Mpps, having 24 x 10/100/1000BASE-T PoE (RJ45) with minimum PoE budget of 180W with 2 x Combo Gigabit RJ-45/ SFP ports and 2 x 10G SFP+ uplink ports. Should support min 1GB internal DRAM, 1GB internal Flash memory, 16K MAC address, 4K VLAN, Latency: < 4 µs. Should have Static Routing, IGMPv3, ISSU, PVST+, LACP, Loopback detection, Built-in CPU protection against malicious attacks. It should be RoHS, WEEE certified and EN 55024: 2010, EN 55022, EN 50581, EN 61000-3-2. The Switch should be managed with both On-premises and Cloud based controller without changing it's Software image.	Nos.
23	Supply installation testing & commissioning of 2x2 Video Wall panels total diagonal size of 110" VIDEO WALL Ultra HD LED Display for Monitoring Multifaceted UHD video wall solution based on a daisy chain through the use of a Display Port, Ultra-narrow 3.5mm bezel-to-bezel. Anti-glare panel (haze 44%), with reliable 24/7 operation. Including Mounting brackets and video wall controller.	Nos.
24	Supply, installation, testing, and commissioning of video wall decoders. The server shall support four monitor displays and be capable of playing multiple cameras through the VMS workstation, as well as displaying alarm windows.	Nos.
25	Supply, Installation, Testing & Commissioning of 1G Single Mode SFP fiber Modules.	Nos.
26	Supply & laying of 3C X1.5 sq. mm Power Cable in existing Conduit.	Meter
27	Supply & laying of 25mm ISI marked MS Conduit including all accessories & mounting hardware etc. complete as required.	Meter

21. AUDIO VISUAL SYSTEM

SI. NO	PRODUCT DESCRIPTION
CONFERENCE/BOARD ROOM	
1	<p>LED DISPLAY: 65" Interactive Display Panel Type New Edge, 60 Hz Resolution 3,840 x 2,160 Pixel Pitch (HxV) 0.372 x 0.372 mm, Brightness (Typical) 350 cd/m² (220 cd/m² with glass), including secure wireless connection, automatic firmware updates, LDAP synchronization, file security and remote management – ensuring a convenient and productive meeting experience Contrast Ratio 4,000:1, Viewing Angle (H/V) 178/178°, Response Time 8 ms, Color Gamut 72 %, Glass Haze: 2 % (without glass), H-Scanning Frequency 30~81 kHz, Maximum Pixel Frequency, 594 MHz, V-Scanning Frequency 48~75 Hz (For Interactive Feature Content need to be shared via Zoom App)</p>
2	<p>Advanced Video Conference System Integrator Kit for Zoom Rooms™ Software, system features Zoom Rooms conferencing software that enables audio and video connectivity for easy collaboration and content sharing Present, call, conference, and collaborate using your own device's UC conference platform (BYOD) or the native Zoom Rooms platform Native Rooms touch screen UI provides a consistent user experience with simple operation and one-touch meeting joins Complete kit contains a 10.1 in. touch screen, UC Presentation Transmitter, and UC Bracket Assembly Network management and provisioning and system alerts through the XiO Cloud® service</p>
3	<p>Supply of an intelligent, high-definition collaboration camera for large meeting rooms with USB Adapter for BYOD application, It features a wide-angle 103° diagonal field of view to capture an entire conference room with Full HD 1080p resolution. High precision aspherical optics, a 20.30 MP 1 in. CMOS sensor, portrait lighting, and advanced video processing ensure an immersive, crystal clear video image free from light or noise artifacts or optical aberrations. The camera has no moving parts, ensuring quiet operation, reliability, and accuracy while adjusting Pan, Tilt and Zoom functions.</p>
4	<p>TeamConnect Ceiling microphone Tile, Patented automatic dynamic beamforming TruVoicelift 28 Electret condenser capsules, made in Germany Perfect speech intelligibility Dante or Analog Output, PoE Certified for: MS Teams, Zoom, DingTalk and Tencent, Exclusion Zones Priority Zone, Camera Control via talker position data IEEE 802.1x</p>
5	<p>Supply of Audio DSP 12 mic/line level inputs with AEC, 8 mic/line level outputs Gigabit Ethernet port, RS-232 serial port, 4-pin GPIO 2-line OLED display with capacitive-touch navigation Rack mountable (1RU)</p>
6	<p>IN-CEILING SPEAKER: Woofer: 6 1/2" (165mm) textured polypropylene cone with a rubber surround, pivoting Tweeter: 1" (25mm) cloth dome, Ferrofluid-cooled, pivoting, in acoustic back chamber Impedance: 8 ohms nominal; 6 ohms minimum Frequency Response: 45Hz - 20kHz ±3dB Power Handling: 5 watts minimum; 125 watts maximum Sensitivity: 89dB SPL (2.83V/1 meter)</p>
7	<p>WiFi streaming audio player: Built-in AirPlay 2 streaming with full metadata to iOS/Android apps or XTS5.5 touchscreens Built-in Chromecast for Audio support with full metadata to iOS/Android apps or XTS5.5 touchscreens Bluetooth Audio, Hi-Res audio streaming support up to 24-bit/192 kHz USB for Flash or external USB Hard drive-based music collections Digital (PCM) and Analog Stereo Inputs Digital or analog output (analog output configurable as fixed or variable)</p>
8	<p>POWER AMPLIFIER: 2-Channel 400W Class D Power Amplifier delivering 200 W per channel at 70 V, 2, 4, 8 and 16 ohms</p>
9	<p>FlipTop™ FT2 Series Cable Management System, 1200 Size, Mechanical, Pass-Through Lid,</p>

	Black
10	AC Power Outlet Module for FT2 Series, Dual, Universal
11	FlipTop™ USB A Rapid Charging Module
12	Pass-Through Cable for FT2 Series, USB-C® to HDMI®, 18 Gbps, 8 ft (2.4 m)
13	Pass-Through Cable for FT2 Series, HDMI® to HDMI, 18 Gbps, 8 ft (2.4 m)
14	FlipTop™ FT2 Series Cable Management System Cable Pass-Through Plate Modules,
15	FlipTop™ FT2 Series Cable Management System Blank Plate Modules,
16	AirMedia® Receiver 3200 with Wi-Fi® Network Connectivity, International
17	AirMedia® Series 3 Connect Adaptor, International
18	Wall Mount Power Pack, 24 VDC, 1.25 A, 2.1 mm, Universal
19	1x2 HDMI Distribution Amplifier
20	8x1 4K60 4:4:4 HDR Presentation System
21	DM Lite® 4K60 4:4:4 Transmitter for HDMI® Signal Extension over CATx Cable
22	DM Lite® 4K60 4:4:4 Receiver for HDMI® Signal Extension over CATx Cable
23	DM Lite® 4K60 4:4:4 Receiver for HDMI® Signal Extension over CATx Cable
LECTURE HALL 185 PAX (1 Nos.)	
1	<p>VIDEO Up to 7,000 lumens of equal Colour and White Brightness1 Full HD WUXGA support; native WUXGA 1920 x 1200 resolution Virtually maintenance-free 20,000-hour laser light source2 Display from 50" to 500" diagonal (16:10) or ultra wide (16:6) Built-in tools for simplified installation</p> <p style="text-align: right;">PROJECTOR:</p>
2	Supply of 150-200"Diagonal Motorised Projection Screen with Aspect Ratio of 16:10
2	Supply of 65"LED DIsplay UHD Signage, optimizing space with its sleek design. <ul style="list-style-type: none"> • Dynamic Crystal Color, with more than one billion shades, delivers an immersive viewing experience. • Industry-leading technology, powered by Quantum Processor Lite 4K, enhances every piece of content for clarity and consistency.
2	1:4 HDMI® Distribution Amplifier w/4K60 4:4:4 & HDR Support, Splits one HDMI® source to four separate outputs. Supports 4K60 4:4:4 and HDR video signals with high-bitrate 7.1 audio.
3	Supply of Ceiling mount kit for Projector
4	Supply of handheld wireless microphone
4	Supply of lapel microphone
4	Supply of Goosneck Microphone
5	Supply of Analog Mixer with 8 mic/line input, Phantom power +48 V,Gain: +15 dB/-15 dB, Frequency: Mono 250 Hz – 5 kHz peaking, Stereo 2.5 kHz peaking
6	<p>IN-CEILING Woofer: 6 1/2" (165mm) textured polypropylene cone with a rubber surround, pivoting Tweeter: 1" (25mm) cloth dome, Ferrofluid-cooled, pivoting, in acoustic back chamber Impedance: 8 ohms nominal; 6 ohms minimum Frequency Response: 45Hz - 20kHz ±3dB Power Handling: 5 watts minimum; 125 watts maximum Sensitivity: 89dB SPL (2.83V/1 meter)</p> <p style="text-align: right;">SPEAKER:</p>
8	<p>POWER 4-Channel 500W Class D Energy Efficient Power Amplifier delivering 4 x 125 W per channel at 70 V, 4, 8 and 16 ohms</p> <p style="text-align: right;">AMPLIFIER:</p>
9	DM Lite® Transmitter and 2x1 Auto-Switcher for HDMI®, VGA, and Analog Audio Signal Extension over CATx Cable, Wall Plate,
10	DM Lite® 4K60 4:4:4 Receiver for HDMI® Signal Extension over CATx Cable
LECTURE HALL-70 PAX (2 Nos.)	
1	<p>VIDEO Up to 7,000 lumens of equal Colour and White Brightness1</p> <p style="text-align: right;">PROJECTOR:</p>

	Full HD WUXGA support; native WUXGA 1920 x 1200 resolution Virtually maintenance-free 20,000-hour laser light source Display from 50" to 500" diagonal (16:10) or ultra wide (16:6) Built-in tools for simplified installation
2	Supply of 120-135" Diagonal Motorised Projection Screen with Aspect Ratio of 16:10
3	Supply of Ceiling mount kit for Projector
4	HANDHELD WIRELESS MICORPHONE: Supply of handheld wireless microphone
4	Supply of lapel microphone
4	Supply of Goosneck Microphone
5	Supply of Analog Mixer with 8 mic/line input, Phantom power +48 V, Gain: +15 dB/-15 dB, Frequency: Mono 250 Hz – 5 kHz peaking, Stereo 2.5 kHz peaking
6	IN-CEILING SPEAKER: Woofer: 6 1/2" (165mm) textured polypropylene cone with a rubber surround, pivoting Tweeter: 1" (25mm) cloth dome, Ferrofluid-cooled, pivoting, in acoustic back chamber Impedance: 8 ohms nominal; 6 ohms minimum Frequency Response: 45Hz - 20kHz ±3dB Power Handling: 5 watts minimum; 125 watts maximum Sensitivity: 89dB SPL (2.83V/1 meter)
7	WiFi streaming audio player: Built-in AirPlay 2 streaming with full metadata to iOS/Android apps or XTS5.5 touchscreens Built-in Chromecast for Audio support with full metadata to iOS/Android apps or XTS5.5 touchscreens Bluetooth Audio, Hi-Res audio streaming support up to 24-bit/192 kHz USB for Flash or external USB Hard drive-based music collections Digital (PCM) and Analog Stereo Inputs Digital or analog output (analog output configurable as fixed or variable)
8	POWER AMPLIFIER: 4-Channel 500W Class D Energy Efficient Power Amplifier delivering 4 x 125 W per channel at 70 V, 4, 8 and 16 ohms
9	DM Lite® Transmitter and 2x1 Auto-Switcher for HDMI®, VGA, and Analog Audio Signal Extension over CATx Cable, Wall Plate,
10	DM Lite® 4K60 4:4:4 Receiver for HDMI® Signal Extension over CATx Cable
Meeting Room (2 Nos.)	
1	LED DISPLAY: 65" Interactive Display Panel Type New Edge, 60 Hz Resolution 3,840 x 2,160 Pixel Pitch (HxV) 0.372 x 0.372 mm, Brightness (Typical) 350 cd/m ² (220 cd/m ² with glass), including secure wireless connection, automatic firmware updates, LDAP synchronization, file security and remote management – ensuring a convenient and productive meeting experience Contrast Ratio 4,000:1, Viewing Angle (H/V) 178/178°, Response Time 8 ms, Color Gamut 72 %, Glass Haze: 2 % (without glass), H-Scanning Frequency 30~81 kHz, Maximum Pixel Frequency, 594 MHz, V-Scanning Frequency 48~75 Hz (For Interactive Feature Content need to be shared via Zoom App)
2	PanaCast® 50 intelligent video bar combines microphones, speakers, and cameras in one front-of-room device. High-quality speakers and microphones deliver exceptional full-duplex performance. Three built-in conferencing cameras capture the room in panoramic 4K resolution with a seamless 180° horizontal field of view. The PanaCast 50 video bar is optimized for all leading UC platforms, including both Microsoft Teams® Rooms and Zoom Rooms® software
3	AirMedia® Receiver 3200 with Wi-Fi® Network Connectivity, International
4	AirMedia® Series 3 Connect Adaptor, International
5	Wall Mount Power Pack, 24 VDC, 1.25 A, 2.1 mm, Universal

22. ACCESS CONTROL SYSTEM

The Integrated Access Control System (ACS) shall function as an electronic access control system and shall integrate with alarm monitoring, CCTV, digital video, ID badging and database management into a single platform.

Technical Specification of 2 Door 2 Reader Access Control Panel

S.No.	Technical Specification		Complied (Yes/No)
1	Applications	Access Control System	
2	CPU	ARM 32 Bit RISC Processor	
3	Memory	Up to 8 MB Flash	
4	No. of Doors	2	
5	No. of Readers	2	
6	Events/Transactions	Up to 2,00,000	
7	No. Users	Up to 1,00,000	
8	Web Server	Available	
9	Door Interlocking/Man Trap	Available	
10	Global APB	Available	
11	SNMP Alerts	Available	
12	MODBUS Protocol Support	Available	
13	AC Fail/Low Battery Alert	Available	
14	Reader Interface	Weigand (upto 34 bit)	
15	Input	6 inputs (2- Door Status, 2- Egress, 1- Fire & 1- intrusion)	
16	Output	4 outputs (2 - DOTL, 2 - Lock)	
17	Communications Port	TCP/IP, RS485	
18	Fire Integration	Yes	
19	Intrusion Integration	Yes	
20	LCD	16X2 LCD Display	
21	Keypad	4X3 Key with soft keypad	
22	Baud Rate	9600bps (Default)	
23	Controller ID	Up to 10,000	
24	Language	English	
25	Power Supply	12 V DC/ 5A	
26	Enclosure	Industry Standard Metal Enclosure	
27	Mounting	Din Rail (Without Metal Enclosure)	
28		Wall mount (With Metal Enclosure)	
29	Facility Code	Available	
30	Time Zone / Access Levels	63 + 1 (Free Time Zone)/Unlimited	
31	Time Zone Slots	4 slots per Day	
32	Anti-Passback	Hard, Soft, Escort (Reader Wise)	
33	Holiday Settings	42	
	General Specification		

S.No.	Technical Specification	Complied (Yes/No)
34	Access Control panel should support 2 Wiegand reader to restrict the entry of unauthorised people at 2 Doors & it should also support 2 Exit switch	
35	Access Control panel should MODBUS connectivity to integrate the panel with BMS (Building Management System)	
36	Should have SNMP Alerts to integrate the panel with IT System Administration software for monitoring critical events	
37	Should have provision of CCTV/IP Camera Integration with Access Events for security audit or to verify/identify tailgating, made effective by alerts based on UDP network protocol.	
38	Access Control Panel Should have Inbuilt Web Server so device can be managed remotely through inbuilt web Server using any web browser.	
39	Device should have inbuilt configurable door interlocking facility for clean environment so vital in sectors such as pharma, data center, etc.	
40	Data download should be automatic or extremely User friendly	
41	The controller must support intrusion i/p & Ethernet networking for communicating on LAN, Intranet and Port Forwarding	
42	It should work Temperature Range upto 50 deg C	
43	Should support Nested Antipass Back to restrict the unauthorised one who got access by tail getting	
44	Facility to set and change the IP address on the device itself. There should be no requirement of PC or laptop to set IP address	
45	5,8,10-digit card nos should be accepted by the system	
46	Indication on unit for Transaction & Users buffer	
47	Facility to create 16 different Authority Levels for Supervisor/Administrator/User on the device	
48	There should be a provision to trigger 3rd party devices like Siren etc. on critical events	
49	There should be a facility to verify card/finger before admin login	
50	The data collection terminals should have backlit LCD display and 2 lines of 16 characters each & 12 key Keypad. The display unit shall continuously display date and time.	
51	Device should be highly secured so that it can communicate with the selected IP/Particular PC only	
52	Device should not accept continuous swipes	
53	Successive swipes should create a soft alert. This feature should be enabled user wise	
54	Employee Name/Emp code/card no should be displayed on the LCD screen along with Access granted	
55	All controller's information should be readable using keypad in offline mode	
56	Holidays restrictions should be reader wise settable	
57	Bulk card adding facility through device	
58	Can be integrated with reader for out entry/exit with Pin + card reader	
59	There should be a facility to activate- deactivate of cards automatically without any human intervention	
60	Provision for silent alarms if any unknown person tries to intrude on gun point.	
61	The Access decisions should be based solely on-site codes	
62	The controller must support 26/32/34/35 bits card readers. Can be integrated with 13.56 MHz or 125KHz cards technology	
63	HID, Mifare and EM card Compatible, Should support any standard Wiegand readers	
64	The Controller should function and record in same way even in standalone mode when network fails.	
65	Provision to integrate with IP cameras, DIS & visitor management software	

S.No.	Technical Specification	Complied (Yes/No)
66	Controller must support inputs from fire panels and Intrusion Panel.	
67	Should support any type of locking devices & remote-controlled exit switch	
68	The controller must have port for connecting egress switch	
69	The controller must have inputs for door sensor.	
70	Common message display on the LCD should be possible	
71	There should be a facility to display company name permanently on the LCD screen	
72	Opening and closing of the doors should be possible from PC	
73	If any person is trying to open the device an alarm should be raised	
74	Ability to respond to access requests/alarm conditions before and during download from the device.	
75	Access Control panel should have power supply with battery charging facility to smooth operation under diverse power infrastructure conditions, should be a facility to connect external battery for battery backup	
76	It should allow specific users to specific Doors/Deptt only	
77	The same Smart Card should be used for Attendance as well as Access Control Systems and should act as ID card as well	
78	The system should be able to keep records in case of Network or Power Failure and once Network or Power is restored, it should be able to communicate with central server without any data loss	
79	The machine should have inbuilt RTC. Provision for setting the time of all machines from a single location to maintain uniform time in all locations	
80	Real time downloading should be supported	
81	Access Panel should have facility to mounting on Din rail without any metal enclosure so very less space will consume in controller room	
82	Mounting/un-mounting and maintenance should have very user friendly with Din rail Mounting facility	
83	Machines to be enclosed in industrial grade heavy duty rugged enclosures at all the locations suitable for all different weather conditions	
84	The connectivity of the devices should be detected remotely from remote machine	
85	Alarm monitoring provision should be available in case of any emergency	
86	There should be a facility to configure the unit in access or attendance mode depending upon the client requirement	
87	Device Should be CE Certified	
88	Component level servicing should be possible.	
89	Total Indian Manufacturing Technology to enable better service and support	
90	When one door is open all other three doors should be locked	
91	Should be provision to integrate Analog Camera and IP Camera and record the short clip/Image for every event	
92	Should be provision to integrate Analog Camera and IP Camera and record the short clip/Image for every event	

Technical Specification of 4 Door 4 Reader Access Control Panel

S.No.	Technical Specification	Complied (Yes/No)
1	Applications	Access Control System

2	CPU	ARM 32 Bit RISC Processor	
3	Memory	(8 MB Flash)	
4	No. of Doors	4	
5	No. of Readers	4	
6	Events/Transactions	Up to 4,00,000	
7	No. Users	Up to 100000	
8	Web Server	Available	
9	Door Interlocking/Man Trap	Available	
10	Global APB	Available	
11	SNMP Alerts	Available	
12	MODBUS Protocol Support	Available	
13	AC Fail/Low Battery Alert	Available	
14	Reader Interface	Weigand (26 bit to 56 bit)	
15	Input	12 inputs (4- Door Status, 4- Egress, 1- Fire & 1- intrusion and 2 Extra input)	
16	Output	12 outputs (4 - DOTL, 4 - Lock, 4 auxiliary output)	
17	Communications Port	TCP/IP, RS485	
18	Fire Integration	Yes	
19	Intrusion Integration	Yes	
20	LCD	16X2 LCD Display	
21	Keypad	4X3 Key with soft keypad	
22	Baud Rate	9600bps (Default)	
23	Controller ID	Up to 10,000	
24	Language	English	
25	Power Supply	12 V DC/ 5A	
26	Enclosure	Industry Standard Metal Enclosure	
27	Mounting	Din Rail (Without Metal Enclosure)	
28		Wall mount (With Metal Enclosure)	
29	Facility Code	Available	
30	Time Zone / Access Levels	63 + 1 (Free Time Zone)/Unlimited	
31	Time Zone Slots	4 slots per Day	
32	Anti-Pass back	Hard, Soft, Escort (Reader Wise),Global	
33	Holiday Settings	42	

Technical Specification of Mifare smart Card Reader

S.No.	Technical Specification		Complied (Yes/No)
1	Read Range	4 -9 cm	
2	Data Read	CSN/Sector	
3	Type	Smart Card (Mifare Classic)	
4	Transmit Frequency	13.56 MHz	
5	Card (Transponder)	Mifare® Series (ISO14443-A)	
6	Card Read Time	0.1 sec	
7	Output Interface	Wiegand Format (32 bits)	
8	LED Indicator	Bi color LED	
9	Power supply	12 V DC @ 100mA	

S.No.	Technical Specification		Complied (Yes/No)
10	Dimensions	80W X 83 H X 21 D	
11	Material	ABS Plastic	
12	Color	Black	
13	Cable Specs (Recommended)	5 cores, 7/36 shielded cable	
14	Cable Distance from Controller:	80m (Wiegand)	
15	Card should be read in 1 sec		
16	A Wiegand output that easily interfaces with most existing Wiegand protocol access control panels. Compact and Elegant. Easily installed on walls and doors.		

Technical Specification of Access Control Software

S.No.	Technical Specification	Complied (Yes/No)
1	Cloud Compatible enterprise level Web based Modular Access Management and Time Attendance software	
2	SQL Database and support up to desired number of users	
3	Single GUI Platform with complete modular software with provision to integrate with different application ie; Access Control, VMS, Alarm Management, etc.	
4	Employee Self Service - login module for Employee/HOD/MANAGER where they can view their attendance; they can apply for leave/manual punch/tour entry/outdoor entry through internet with their login ID & password.	
5	Same way manager can online approve all application sent by employee. Comprehensive Email and SMS module for to send various SMS & Email on the base of different events in Access Control & Time Attendance system.	
6	It should support Multi company, multi-location, multi department, multi login with different rights, multi hierarchy of employee, Should support maker & checker facility - the local administrator should be able to add the users but he should not be able to authenticate/approve the User, Approval right of the added user should be with main Administrator.	
7	Dedicated output reports for Payroll integration, Duress Authentications, Email & SMS can be sent on every configured event ie; Leave Application/approval, Manual Punch Application/Approval, Outdoor Application/Approval, Tour Application/ Approval, Condone Application/ Approval.	
8	Holiday restriction (Reader Wise), Device Configuration - Push/Pull, Dual Authentications, Easy Employee tracking as outdoor Employee Attendance should mark with their GPS Location, Employee can mark Offline attendance (If No Network) through Android Mobile App.	

Technical Specification of Access Control Server

S.No.	Technical Specification		Complied (Yes/No)
1	Processor	Intel i7 or Xeon	
2	RAM	16GB	
3	OS	Window 10 or Latest	
4	Graphic Card	4GB Graphic Card	
5	Internal storage	1TB	
6	Ethernet Port	02 Gigabit LAN	
7	Monitor	19-inch	

9	Accessories	Keyboard, Mouse & Associated Cables	
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Technical Specification of Mifare Smart Card

S.No.	Technical Specification	Complied (Yes/No)
1	Mifare Smart Card Contactless transmission of data and supply energy (No battery needed)	
2	Operating Distance: Upto 100mm (Depending on Antenna Geometry)	
3	Operating Frequency: 13.56 MHZ.	
4	Fast Data Transfer: 106 Kbit/s High Data Integrity: 16 Bit CRC, parity, bit coding, bit counting. 1 Kbyte, organized in 16 sectors with 4 blocks of 16bytes each (one block consists of 16 byte)	
5	User definable access conditions for each memory block. Data retention of 10 years.	
6	Mutual three pass authentication (ISO/IEC DIS9798-2), Data encryption on RF-Channel with replay attack protection.	
7	Individual set of two keys per sector (per application) to support multi-application with key hierarchy.	
8	Unique serial number for each device. Transport key protects access to EEPROM on chip delivery.	

Technical Specification of Electromagnetic Lock 600 lbs

S.No.	Technical Specification	Complied (Yes/No)
1	Operating Voltage 12VDC or 24VDC (Adjustable)	
2	Current Draw 500mA	
3	Holding Force Up to 600 LBS	
4	Operating Temperature -20C to 60C	
5	Mounting type Surface	
6	LED Indication YES	

Technical Specification of Electromagnetic Lock 1200 lbs

S.No.	Technical Specification	Complied (Yes/No)
1	Operating Voltage 12VDC or 24VDC (Adjustable)	
2	Current Draw 500mA	
3	Holding Force Up to 1200 LBS	
4	Operating Temperature -20C to 60C	
5	Mounting type Surface	
6	LED Indication YES	

Technical Specification of Exit push button

S.No.	Technical Specification	Complied (Yes/No)
1	Contact Rating: 3A/125-250VAC	
2	Output Contact: NO/COM	
3	Mechanical Life: 100,000 Tests	
4	Button Colour: Silvery	
5	Operating Temperature: -20°C~+55°C(14-131F)	
6	Suitable Humidity: 0-95% (relative humidity)	
7	Panel: 0.9mm Thick 304 Stainless Steel	
8	Surface Mount: Optional M40 Back Box	

Technical Specification of 8Cx 0.5 sq mm Access Control Cable

S.No.	Technical Specification	Complied (Yes/No)
1	8 Core x 0.5 sq mm Size	
2	Multi strand Copper	
3	Unarmoured shielded	
4	PVC Jacket	

Technical Specification of 2Cx 1.5 sq mm Access Control Cable

S.No.	Technical Specification	Complied (Yes/No)
1	2 Core x 1.5 sq mm Size	
2	Multi strand Copper	
3	Twisted unshielded	
4	FRLS	
5	PVC Jacket	

Technical Specification of Desktop Based Visitor Management Software

S.No.	Technical Specification	Complied (Yes/No)
1	Visitor Identification & Management software should have designed to cater from small offices to multi buildings premises. The software serves the purpose to avoid long queue and unwanted visitor in an organization. The software collects and maintains visitor information in an organized manner which helps the organization to deal with visitor's data in effective way	
2	System should register and verify and generate the gate pass for all three kind of visitors - For Walk in Visitor, For Repeat Visitor & For Visitor with Pre-scheduled Appointment	
3	Should have separate module for Security Guard/Reception, Admin & Host employee (All module should be installed in secured Computer and should not accessible from any Browser from any other place/computer)	
4	VMS should have integrated with: -	
5	Finger Print Scanner – For Enroll & Identify Visitor's Fingerprint	
6	Web Cam – For Capture visitor's photograph	
7	Printer – To print the visitor Passes	
8	Digital signature – to capture signature of visitor	
9	Barcode Reader – Read the barcode of visitor pass to identify & logout visitor	
10	Business Card Reader – To read visitor's details quickly from business card	
11	SMS Gateway – To send SMS to Visitor (unique Code) & Host (about Visitor)	
12	Email Server – To send Email to Visitor (unique Code) & Host (about Visitor with photograph)	
13	Access Control System – To give access to visitor on only specific access control reader through visitor card	
14	Should have Customized Visitor Pass: - Visitor Pass can be customized as per organization requirement. All the fields available on pass can be configured (size, placement, font, etc.)	
15	Pre-schedule an Appointment - Employee/Host can schedule and appointment of visitor in advance so security person will generate visitor pass smoothly & quickly, it avoids long queue at reception/security gate.	
16	No fake Visitor – To generate visitor pass an unique code sent on visitor mobile no. and same will verified before printing the visitor pass	
17	Controlled Access for Visitor (Inside Premises) – Access card can be given to visitor for access the premises with restrictions of entry, so visitor can access only those doors where they have right to access.	

S.No.	Technical Specification	Complied (Yes/No)
18	Email with Visitor Photograph - Security personal send the mail with visitor's photograph to host for approval, so host can see the visitor and then can give	
19	Anytime Anywhere Accessibility - Web based smart VISITOR installed on web server/Cloud so it can be accessible by Admin/host anytime anywhere on internet.	
20	Visitor/Company Blacklist: - Host/employee can blacklist any visitor/company, so if they come again then it will be identified on reception itself and they will not able to enter in the premises.	
21	Monthly Passes for Contractor: - Periodically/Monthly pass can be generated for contractor so they can enter the premises without day-to-day hassle and same can be identified by organization security personnel also.	
22	Vehicle Management: - Visitor's Vehicle details registered with visitor details for future security audit in case of any security mishap happen due to visitor's vehicle.	
23	VMS should generate minimum these reports - Visitor Report, Security wise Visitor Report, Employee/Host wise Visitor report, Contract Visitor Report, Preapproved visitors, watch list visitor, ban list visitors, Removed from watch list/ ban list visitors, Access Card Available Reports, Transaction Reports, Appointment Reports, Visitor Report (Status wise search)	

Technical Specification of Boom Barrier

S.No.	Technical Specification		Complied (Yes/No)
1	Application	Indoor / Outdoor	
2	Drive Motor	Electro-Mechanical DC Brushless	
3	Type of Use	Intensive	
4	Frequency of Use	100%	
5	Motor Power Supply	24V DC	
6	Absorbed Power	100 Watt	
7	Protection Degree	IP 65 (IP 67 Operator)	
8	Adjustable Thrust	Yes	
9	Decelerations	Yes	
10	Torque	180 NM	
11	RPM	1800 RPM	
12	Operating Voltage	AC 230V (+/-10%), 50Hz	
13	Environment Condition	-25°C to +70°C (RH 10% - 95%)	
14	Type of Boom Balancing	Compression Spring	
15	The Height of Boom Support	890 MM	
16	Encoder/Limit Switch	Available	
17	Housing Colour	Red	
18	Boom Arm Material	Octagonal Aluminium with Rubber protection	

19	Certification	CE	
20	MCBF (Mean Cycle Between Failure)	12 Millions	
21	Arm Length	Max. 6 mtr	
22	No. of Digital Inputs	8	
23	No. of Relays/Digital Outputs	6/4	
24	Modular Expansion of Control System	Radio receiver and other detector modules	
25	Maximum Remote Control Distance	Less than 30 M	
26	Integrated and Access Control	Compatible with all kinds of access equipment Seamless integration with Parking Management System	

Technical Specification of Bollard

S.No.	Technical Specification		Complied (Yes/No)
1	Drive	Hydraulic Inbuilt	
2	Cylinder height from ground	1000mm	
3	Cylinder diameter	275mm	
4	Cylinder Thickness	18 mm	
5	Cylinder material	High Tensile carbon steel Grade B (ASTM A1006)	
6	Cylinder Finish	polyester powder paint (Dark grey metallized RAL 7021 or customised)	
7	Cylinder head	Aluminium	
8	Illumination	LED with Reflective Stickers (red/white/yellow)	
9	Ground cover material	Chequered Aluminium Plate	
10	Ground cover treatment	Galvanised	
11	Rising time	6 sec	
12	Lowering time	4 sec	
13	Emergency Manual Lowering	YES. With Special Key Release	
14	Emergency lowering time	2 sec	
15	Gentle Stop function	YES	
16	Axle Load	25 Ton	
17	Max force	9000 N	
18	Load class (EN 124)	C 30/37	
19	Impact resistance	715000 J	
20	Crash Certification Standard	BSI PAS 68:2013 48 km/h, IWA 14-1:2013 48 km/h.	
21	Impact Rating Classification	K4	
22	Usage	Intensive Use (300 full cycle/hr)	
23	MCBF	5 million cycles	
24	MTTR	30 min	
25	Power Supply	Three Phase 380-415V AC 3PH 50-60Hz	
26	Control Unit	Microprocessor	
27	Max consumption	1500 W	
28	Operating temperature	-15°C / +60°C	
29	Operating temperature with heater/ cooling fan	-25°C / +70°C	

30	Ingress Protection	IP 67	
31	Certification	CE, ISO	
32	Excavation dimensions (L*W*D)	3100*1600*1800 mm	

Technical Specification of Baggage Scanner

S.No.	Technical Specification		Complied (Yes/No)
	General Specifications		
1	Tunnel Dimensions	606mm(W) x 420mm(H)	
2	Conveyor Speed	0.20m/s	
3	Conveyor Height	680mm	
4	Max. Load	160kg	
	Image Performance		
5	Wire Resolution	38AWG	
6	Steel Penetration	35mm	
7	Display Resolution	1280 x1024	
	Image Processing System		
8	Image Enhancement	Color/BW, negative, high/low penetration, organic /inorganic stripping, general enhancement, multi-absorptivity, and suspect material enhancement, etc.	
9	Material Classification	According to atomic number signatures	
10	ROI & Zoom	Step/stepless zoom, up to 32 times enlargement	
11	Image Recall	Preceding images recallable	
12	Image Storage Capability	Up to 50,000	
	Miscellaneous Functions		
13	Standard Functions	Time/date display, counters, user management, system-on/X-ray-on timers, power on self-test, built-in diagnostic facilities, dual-direction scanning, system log, system standby and training, etc.	
14	Optional Functions	Explosives/narcotics detections, high-density area alert, threat image projection (TIP)	
	Health and Safety		
15	X-ray Leakage	Less than 1μGy/ h (5cm from the housing complying with all published international standards	
16	Film Safety	Guaranteed for high-speed film up to ASA/ISO1600 (33DIN)	
	Physical Data		
17	Dimensions	2042mm(L) x 850mm(W) x1300mm(H)	
18	Weight	640kg	
19	Storage Temperature/ Humidity	-40°C ~ +60°C/ 5% ~ 95% (non-condensing)	
20	Operating Temperature/ Humidity	0°C ~ +50°C / 5% ~ 95% (non-condensing)	
21	Power Supply	230VAC (-15% ~ +10%), 50 Hz ±3Hz	
22	Power Consumption	0.8kVA	

Access Control BoQ

S.No.	Item Description	Unit
A.	ACCESS CONTROL SYSTEM	

S.No.	Item Description	Unit
1	Supply, Installation, Testing & Commissioning of 2 Door 2 reader access control panel with onboard 32-Bit RISC ARM CPU, 8MB flash memory, shall support up to 100000 card user, 400000 event transactions, TCP/IP, the panel should have inbuilt 4 GB SD memory card to take mirror image of device configuration. data shall support standard Wiegand readers, Access Control panel should have MODBUS connectivity to integrate the panel with BMS (Building Management System), with metal enclosure & inbuilt power supply, facility of din-rail mounting should available. capable to integrate with IP/CCTV & NVR for access event alerts, Inbuilt door interlocking facility, SNMP alerts facility, Low battery and AC fail alert facility & reader Tamper detection alert facility should available	Nos.
2	Supply, Installation, testing and commissioning of 12/16 V SMPS DC Power Supply Unit, highly regulated and spikes free terminal voltage and heavy sourcing current for regulated terminal voltage.	Nos.
3	Supply, Installation, Testing & Commissioning of Mifare smart Card Reader Technical Specs. Read Range -4-9 cms Data Read CSN/Sector Transmit Frequency 13.56 MHz Card (Transponder) Mifare® Series (ISO14443-A) Card Read Time 0.1 Sec Output Interface Wiegand Format (32 Bits) LED Indicator Bi Color LED Power supply 12V DC @ 100mA Material Abs Plastic Card should be read in1 sec A Wiegand output that easily interfaces with most existing Wiegand protocol access control panels. Compact and Elegant. Easily installed on walls and doors.	Nos.
4	Supply, Installation, Testing & Commissioning of Cloud Compatible enterprise level Web based Modular Access Management and Time Attendance software with SQL Database and support up to desired number of users. Single GUI Platform with complete modular software with provision to integrate with different application ie; Access Control, VMS, Alarm Management, etc. Employee Self Service - login module for Employee/HOD/MANAGER where they can view their attendance; they can apply for leave/manual punch/tour entry/outdoor entry though internet with their login ID & password. Same way manager can online approve all application sent by employee. Comprehensive Email and SMS module for to send various SMS & Email on the base of different events in Access Control & Time Attendance system. It should support Multi company, multi-location, multi department, multi login with different rights, muti hierarchy of employee, Should support maker & checker facility - the local administrator should able to add the users but he should not able to authenticate/approve the User, Approval right of the added user should be with main Administrator. Dedicated output reports for Payroll integration, Duress Authentications, Email & SMS can be sent on every configured event ie; Leave Application/approval, Manual Punch Application/Approval, Outdoor Application/Approval, Tour Application/Approval, Condone Application/Approval. Holiday restriction (Reader Wise), Device Configuration - Push/Pull, Dual Authentications, Easy Employee tracking as outdoor Employee Attendance should marked with their GPS Location, Employee can mark Offline attendance (If No Network) through Android Mobile App.	Nos.
5	Supply, Installation, Testing & Commissioning of Server/PC for Access Control Software, Server should have Intel i7 or Xeon processor, 4GB Graphic Card, 1TB Hard Disk, 16 GB RAM, Suitable OS, Keyboard, Mouse, 19" Monitor with all accessories.	Nos.
6	Supply, Installation, Testing & Commissioning of Mifare Smart Card Contactless transmission of data and supply energy (No battery needed), Operating Distance: Upto 100mm (Depending on Antenna Geometry), Operating Frequency: 13.56 MHZ. Fast Data Transfer: 106 Kbit/s High Data Integrity: 16 Bit CRC, parity, bit coding, bit counting. 1 Kbyte, organized in 16 sectors with 4 blocks of 16bytes each (one block consists of 16 byte), User definable access conditions for each memory block. Data retention of 10 years. Mutual three pass authentication (ISO/IEC DIS9798-2), Data encryption on RF-Channel with replay attack protection. Individual set of two keys per sector (per application) to support multi-application with key hierarchy. Unique serial number for each device. Transport key protects access to EEPROM on chip delivery.	Nos.
7	Supply, Installation, Testing & Commissioning of Electromagnetic Lock 1200 lbs, Single	Nos.

S.No.	Item Description	Unit
	leaf, LED Status Display,	
8	Supply, Installation, Testing and commissioning of Exit push button as required.	Nos.
9	Supply, Installation, Testing & Commissioning of U/L Clamp made of aluminum anodized for EM Lock.	Nos.
10	Supply and Laying of 8 Core x 0.5 sq mm multi strand, copper, unarmored shielded Cable as per specification (between the every card readers & the access controllers)	Mtr.
11	Supply & laying of Supply and drawing of 2 C X 1.5 Sq mm multi stranded twisted unshielded FRLS Copper cable for Access control system.	Mtr.
12	Supply, Installation, Testing & Commissioning of Category 6A U/UTP LSZH Cable, Flame Rating IEC 60332-1, 23 AWG solid copper conductors in accordance to TIA/EIA 568.2-D (Category 6) & ISO/IEC 11801 2nd ed(Class Ea), ETL 04-Connector Channel Verified with MTPL, tested @600 Mhz or more, with HDPE insulation of individual conductor and over all Dia of 5.9 ± 0.3 mm with Cross-filler and cable shall not have any kind of Non Metallic Barrier Tape or Metallic Shield inside for Connectivity of Hub room to End Point on surface/ recess/ in existing pipe/ open duct complete etc. as required.	Mtr.

TECHNICAL SPECIFICATIONS FOR DFMD

Sr. No.	Technical Specifications	COMPLIANCE
DETECTION CAPABILITY	The equipment shall detect metal weapons carried on a person, however they are worn through the archway, independently of their orientation, trajectory and transit speed. More specifically, the equipment shall be able to detect magnetic, non magnetic and magnetic/non magnetic mixed alloy metal weapons singularly, assembled and/or disassembled (considering for each weapon the highest metallic contribution) or combined.	
	The detection capability of the WTMD shall be stable without variation. The WTMD shall not require periodic recalibration.	
	The sensitivity of the archway shall be adjustable in order to provide the widest dynamic threat object detection range from guns to very small blades like a half cutter blade (HCB security level).	
CANCELLATION EFFECTS	The detection capability shall not be degraded by combinations of different types of metals.	
DETECTION SPEED	The Metal Detector shall detect the metal test pieces independently of their speed of transit through the archway (range: 0.3 ... 15m/s). This requires constant sensitivity for variations in speed.	
ERGONOMICS – VISUAL AND ACOUSTICAL INDICATIONS	The WTMD shall be fitted with four full-height luminous bars, placed two at the entrance (right and left side) and two at the exit side of the archway (right and left side) to provide very clear visual indications according to the different conditions of the daylight.	

Sr. No.	Technical Specifications	COMPLIANCE
	Zone indication shall be with minimum 20 vertical floating zones for the best pinpointing of the detected metal object and the maximum resolution with a total of 60 zones (20 vertical x 3 horizontal) in the complete archway.	
	The four multi-zone display bars shall be programmable independently as entry Stop/Go (pacing lights) indication and/or localization lights in order to improve the ergonomics and visibility of the indications and the easiness of installation.	
	It shall be possible to operate the WTMD in both transit directions. Pacing lights (Stop/Go indication) and/or localization lights shall be activated simultaneously on both sides of the archway.	
	Metal type indication: in case of alarm, the control unit shall be able to display the type of metal detected (ferrous/no ferrous). It shall be possible to enabled/disabled the metal type indication through the WTMD programming.	
	The WTMD must have an automatic procedure for daily test activated with a Chip-card. The test result shall be displayed on the control unit.	
<u>TECHNICAL SPECIFICATIONS</u>		
MECHANICAL DIMENSIONS/ WEIGHTS	The minimum WTMD's passage width shall be 700 mm and the minimum WTMD's passage height shall be 2010 mm.	
	The WTMD's external dimensions shall be lower than 880 x 2300 mm (Width x Height).	
MECHANICAL CHARACTERISTICS	The WTMD mechanical structure shall maximize the protection against wear and tear. The WTMD mechanical structure shall be very robust in order to guarantee the maximum protection against damages.	
	The construction of the WTMD shall be modular and designed in order to minimize the number of components.	
	The WTMDs shall be designed in order to be assembled and disassembled quickly. The maximum allowed time for the assembling of the complete gate shall be lower than 10 minutes.	
	The WTMD shall be a stand-alone unit, provided with smooth, robust and washable surfaces.	
	The WTMD shall be equipped in the lower side with protections against damages due to bumps of floor cleaning machineries and sprinkling of water or other substances.	
	All of the electronics shall be mounted to the crosspiece at the top of the archway.	
	The WTMD shall be equipped with four anchoring points to the floor.	
	The equipment shall have the IP65 rating for outdoor applications.	

Sr. No.	Technical Specifications	COMPLIANCE
ELECTRICAL CHARACTERISTICS	The WTMD shall be designed in order to provide the highest immunity towards external electrical and mechanical interferences in order to improve the easiness of installation in any kind of environment-layout.	
	The correct working of the WTMD is required even when two WTMDs are installed at a reciprocal gate distance of 15 cm, without the use of synchronization cable(s) and/or jumpers.	
	The WTMD shall be equipped with a self diagnosis system which ensures the immediate signaling of faults or performance changes at start-up and during operation as well.	
	The WTMD shall be equipped with two photocells for an automatic and very high precision bidirectional counting (number of entering and exiting persons) and statistical evaluation of transiting people and alarms.	
	For security reasons the WTMD shall be always active. The use of photocells (infrared sensors) to avoid the alarm of the WTMD caused by nearby moving metallic materials or external electrical interferences is not allowed.	
	The maximum allowed power absorption of the WTMDs shall be 40W.	
<u>PROGRAMMING AND CONNECTIVITY</u>	The WTMD shall have a minimum of five programming methods:	
	Chip-card	
	Local using keypad on the control unit	
	Remote through a RS232 port and a laptop	
	Infrared (IR) Remote Control (password protected)	
	Bluetooth	
	The selection of the security level shall be extremely quick by the use of dedicated chip-card.	
	The WTMD's programming access shall be protected by a mechanical lock and by a password made up of 6 alphanumeric characters. The WTMD shall have two independent levels of programming (user and super user), each one protected by a password.	
	The equipment shall be designed in order to improve the easiness and quickness of programming and set-up: a "one touch self installation" procedure shall be available. The self-installation procedure shall consists of a sequence of tests and adjustments, regarding the following aspects: operation of the signaling devices, relevant electrical parameters, archway configuration and the electromagnetic compatibility with the installation site (instruction for each step shall be displayed on the control unit display).	

Sr. No.	Technical Specifications	COMPLIANCE
	A function that searches automatically a suitable transmission channel, i.e. a channel with minimum interaction with possible sources of interference present in the installation site, shall be available. The selected transmission channel shall be shown at the end of the process.	
	The equipment shall be able to acquire the value of the signals received by the probe and shall adjust itself in order to increase its immunity against possible sources of interferences (environmental noise adjustment function). An additional function shall provide in the control unit display the read out of the signals measured by the probe as a percentage of the alarm threshold in order to identify a suitable detector position if the installation site contains sources of interferences.	
	A procedure to acquire and compensate the interferences generated by mechanical vibrations due, for instance, to floor oscillations, strong air compressions or wind shall be available.	
<u>ENVIRONMENTAL CHARACTERISTICS</u>	Storage temperature: from -31°F (-35°C) to 158°F (70°C).	
	Working temperature from -4°F (-20°C) to 158°F (+70°C).	
	Relative storage humidity: from 0 to 95 % without condensation	
	Relative working humidity: from 0 to 95 % without condensation	
<u>ELECTRICAL SAFETY, HARMLESSNESS AND CERTIFICATIONS</u>	The WTMD shall be certified by an accredited and operating independent Laboratory as conforming to International Standards on the Human Exposure to Electromagnetic Fields. Manufacturer shall provide documentation.	
	Electrical Safety: for safety reasons, in order to avoid any probability of electrical hazard, the WTMD shall be powered by a nominal voltage to ground not exceeding 50V (CAT.0) to prevent the risk of people in transit coming into accidental contact with parts of the gate powered at mains voltage.	
	The WTMD must use CW (continuous wave) magnetic fields (pulsed fields are not allowed) for best pace-maker and vital supports harmless.	
	The WTMD shall not interfere with medical devices such as hearing aids, cardiac stimulators, defibrillators, neurological stimulators.	

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23. STRUCTURED CABLING

Technical Specification of Single Mode OS2 Fiber Cable

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make:	To be Specified by the Bidder	
2	Quoted Model:	To be Specified by the Bidder	
3	Type	6F Core Single mode (9/125µm) G652 Fiber optic Outdoor Cable	
4	Cable	6F Core Single Mode Uniloose Tube, Single Sheath, Fiber cable is perfectly suited for both gigabit Ethernet and 10 gigabit Ethernet campus and backbone applications	
5	Application	Cable are perfectly suited for both gigabit Ethernet and 10 gigabit Ethernet campus and backbone applications.	
6	Outer Sheath	UV Resistance LSZH Jacket / Black	
7	No. of Tube / Tube diameter	1 / 3.0 ± 0.1 mm	
8	Water Blocking Material	WS Tape	
9	Loose Tube Construction	Std. plywood reel: Uniloose Tube, Water Blocking with fibres. Individually colour coded optical fibres as per Global Standards	
10	Cable Specifications	Fiber Color/ Fibers per Tube: Blue, Orange, Green, Brown, Grey, White, Red, Black, Yellow, Violet, Pink, Aqua Cable diameter: 9.0 ± 0.5 mm	
11	Optical Properties	Core non-circularity: ≤ 6 %	
		Cladding Diameter: 125.0 ± 0.7 µm	
		Core/cladding Concentricity Error: ≤ 0.6µm	
		Cladding non-circularity: ≤ 1.0 %	
		Primary Coating Diameter: 245±10µm	
		Coating/cladding Concentricity Error: ≤ 12µm	
		Attenuation Co-efficient	
		1310 Wavelength (nm): ≤0.36 dB/km	
		1550 Wavelength (nm): ≤0.24 dB/km	
		1625 Wavelength (nm): ≤0.26 dB/km	
		Chromatic dispersion:	
		1285 ~ 1330nm ≤ 3.4ps/(nm·km)	
		1550nm ≤18 ps/(nm·km)	
		1625nm ≤ 22 ps/(nm·km)	
		Cutoff Wavelength ≤ 1260 nm	
		PMDQ (Quadrature average*): ≤ 0.20 ps//km ^{1/2}	
MFD: 9.1 ± 0.4 µm at 1310nm			
MFD: 10.3 ± 0.5 µm at 1550nm			
Zero dispersion slope: ≤ 0.092ps/ (nm ² ·km)			
Zero dispersion wavelength: 1300~1324nm			
12	Temperature Range	Storage Temperature Range: -40°C to +70°C	
		Installation Temperature Range: -10°C to +70°C	
		Operating Temperature Range: -40°C to +70 °C	
13	Physical Properties	Complies to ANSI/TIA-568.3-D, ITU-T G652.D, Telcordia GR-20, IEC 60794-2, ISO/IEC 11801, ISO/IEC 24702	
		Cable Bend Radius: 20 x Cable Diam.	
		Cable Kink Radius: 10 x Cable Diam.	
		Cable Max. Tensile Strength (Short Term): 1500 N	

S.No.	Parameter	Specification	Complied (Yes/No)
		Cable Max. Crush Resistance (Short Term): 2000 N / 100mm	
		Impact Resistance: 25 Nm	
14	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of 6/12/24/48 Fiber Patch Panel LIU

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make:	To be Specified by the Bidder	
2	Quoted Model:	To be Specified by the Bidder	
3	Type	1U Rack Mount Fiber Enclosure (LIU) including Splice Trays and Adapter Strips which accepts loose tube & distribution cable	
4	Fiber Interface Unit	Fiber Patch Panel Typically used in Server rooms, Network rooms, Data Centres and Small offices Can be mounted directly on any 19" rack or cabinet. It should be able to accommodate a variety of Fiber connectors and terminated to fiber cables using Splicing or other methods.	
5	Type	Fiber LIU should be 1U, 19 Inch Rack Mount. 6/12/24/48 Port should be available in 1U Rack Mount LIU.	
6	Features & Compatibility	The Fiber Panels are designed with fixed mount adapter plate assemblies.	
		Sliding design, this panel allows easy access during installation or rework without disturbing previously terminated fiber cable.	
		This also offers multiple cable entries to provide various customized solutions as per the customers' requirement.	
		This panel comes with adaptor plates which are preloaded with coupler and can snap in for installation and can be removed easily for future changes.	
		900m Tight buffer pigtailed are provided with this panel. This panel is preloaded with Splice tray & necessary fiber management accessories.	
7	Material	Panel be constructed with SPCC (Cold rolled steel sheet)	
8	Standards	Conformance to Single Mode (ANSI/TIA-568.3-D, Telcordia GR-326-CORE, Telcordia GR-1221-CORE, ISO/IEC 11801, IEC 61754 & IEC 61300 series), Multi-Mode (ANSI/TIA-568.3-D, IEC 61300-3-4, IEC 61300-3-6, IEC 60874-1, ISO/IEC 11801)	
9	Adapter Types	Pigtails consist of LC, SC, FC, ST, MTRJ, and E2000 Connectors.	
10	Pigtails Type	Pigtails shall be constructed with bend Insensitive Fiber	
11	Insertion Loss	≤0.2 dB (Singlemode), ≤0.3 dB (Multimode)	
12	Return Loss	≥50 dB (UPC), (Singlemode), ≥60 dB (APC) (Singlemode), ≥35 dB (UPC) (Multimode),	
13	Repeatability	≤0.1dB	
14	Durability	≤0.2 dB, 1000mattings	
15	Ferrule Material	Zirconia Ceramic	
16	Operating Temperature	-25 °C to +70 °C	
17	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of LC-LC/LC-SC Fiber Patch Cord

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make:	To be Specified by the Bidder	
2	Quoted Model:	To be Specified by the Bidder	
3	Features	The armored patch cord uses metal tube inside the outer jacket as an armor to protect the fiber glass inside	
		The protective layer of Metal braiding is adopted, which has excellent side pressure resistance, flexibility and bending performance.	
		Good mechanical and temperature characteristics.	
		Small diameter, lightweight, easy to connect and support large capacity data transmission.	
4	Fiber Count	2	
5	Outer jacket OD	3.0 mm X 2	
6	Metal tube OD	1.4 ± 0.3 mm	
7	Insertion Loss	≤0.2 dB (Singlemode), ≤0.3 dB (Multimode)	
8	Return Loss	≥50 dB (UPC), (Singlemode), ≥60 dB (APC) (Singlemode), ≥35 dB (UPC) (Multimode),	
9	Durability	≤0.2 (1000 mattings)	
10	Minimum allowable Tensile strength(N)	500 (short Term),300(Long Term)	
12	Minimum allowable Crush Load strength(N/100mm)	3000 (short Term),2000(Long Term)	
13	Minimum bending radius(mm)	20D (short Term),10D (Long Term)	
14	Operating Temperature	-20°C to + 75°C	
15	Storage Temperature	-20°C to + 85°C	
16	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of CAT6A U/UTP LSZH Cable

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	CAT6A U/UTP LSZH Cable	
3	Type	23 AWG solid bare copper, Unshielded Twisted 4 Pair, Category 6A, confirming to ANSI-TIA 568.2-D for Category 6 & ISO/IEC 11801 for Class Ea.	
4	Conductors	Solid bare copper 23 AWG	
5	Pair Separator	+ Shape Spline	
6	Packing	Box of 305 meters	
7	Cable Outer Diameter	7.2 ± 0.3 mm	
8	Minimum Bening radius	8 X cable diameter	
9	Conductor Resistance	≤ 93.8 Ω/km	
10	Pulling Force	100 N	
11	Nom. Velocity of Propagation	69%	
12	Operation Temperature Range	-20 °C to +70 °C	

13	Flame Properties	Flammability Test : IEC 60332-1	
		Acid Gas Emission Test : IEC 60754-1	
		Smoke Density Test : IEC 61034	
14	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of CAT 6A Patch Panel

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	24 Port, 1U Staggered Patch Panel, Unloaded - 1U	
4	Type	24 Port 1U Unloaded ZigZag / Staggered Patch Panel The design reduces Alien Crosstalk to support IEEE 802.3an and ANSI/TIA 568.2-D.	
		Patch panels IDC (IDC of Information Outlet) Connectivity Snap in Type should be at rear end & RJ-45 jack on front panel, 19" rack mountable.	
		Patch panels Ports should be individually replaceable & Consistent port-to-port performance and includes grounding bolt	
5	Availability	Patch Panel should be available with 24 Ports in 1U	
6	Cable management	Straight Patch Panel with Angled Information Outlet Slot that makes patch cord routing easier and eliminate the need for Horizontal Cable Management.	
7	Compatibility	Patch Panel should be able to accept Cat6A, Cat6 and Cat5e information outlets for backward and forward compatibility	
8	Height	1U (1.75")	
9	Storage Temperature Range	-40Deg C to +70 Deg C	
10	Operating Temperature range	-10Deg C to +60 Deg C	
11	Humidity	10% - 90% RH	
12	Color and Material	Metal SPCC, Black, plastic inserts, Double layer - 1.5mm, provided with mini cable ties, cage nuts & rare cable management.	
13	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Shall be tested for Corrosion as per ASTM B117: 2019. (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of CAT 6A I/O (Information Outlet)

S.No.	Parameter	Specification	Complied (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
2	Type	CAT6A Modular Jack	
3	Type	Modular Jacks shall meet and exceed channel specification of ANSI/TIA 568.D-2, IEC/ISO 11801 & IEC 60603-7-41 when used as a component in a properly installed UTP channel.	
4	IDC Connector	0.5mm Phosphor bronze , Tin-plating contacts	

5	PCB Material & Thickness	FR-4, 1.2mm thickness	
6	Jack wire material and thickness	0.35mm Phosphor bronze gold over nickel plating	
7	Termination Interface	Front Mated Connection: 750 Cycles	
		Rear Mated Connection: 200 Cycles	
8	Plug and Outlet Contact force	≥ 100 Grams with FCC Compliant RJ-45 plug	
9	Plug Retention Strength	13.5kg	
10	Contact Compatibility	Accommodates 23 to 26AWG solid	
11	Termination Pattern	TIA / EIA 568 A and B	
12	Retention Strength	5kgs between Jack and Plug	
13	Storage Temperature :	-40° to +68°C	
14	Electrical Performance	Insulation Resistance : ≥ 500mΩ	
		Contact Resistance : ≤10mΩ	
		Current rating : 1.5 Amps	
		DC Resistance : ≤ 0.1Ω	
		DC/AC Volt Endurance : DC1000V/AC750V 1min	
15	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863	

Technical Specification of CAT 6A Patch Cord

S.No.	Parameter	Specification	Complied (Yes/No)
1	Type	CAT6A Unshielded Modular Cord shall meet and exceed channel specification of ANSI/TIA 568.2-D, ISO/IEC 11801 Standard.	
2	Conductor	Flexible Stranded Bare Copper, 24 AWG	
3	Jacket thickness	0.6 ± 0.02mm with LSZH jacket manufactured using an antibacterial agent (biocide) can suppress the growth of bacteria on the surfaces of products when conditions exist where growth can occur	
4	Feature	Improved Strain Relief boot with Soft latch-cover design for easy depression	
5		Backward compatible for easy integration with any network component that uses a RJ45 connection	
6	Length	1 / 2 / 3 / 5 Meter & Customized length	
7	Connectors	High Grade 50 μ gold plated RJ45 Connectors	
8	Conductor Material	Stranded Bare Copper	
9	Operating Temperature Range	-10 °C to +60°C	
10	Storage Temperature Range:	-20 °C to +70°C	
11	Installation Temperature:	0 °C to +50°C	
12	Sheath Material	LSZH	
13	Cable Diameter	7.2 ± 0.5 mm	
14	Electrical Specification:	Conductor DC Resistance: 14Ω / 100m	
15		Resistance Unbalance: 50mΩ	
16		Impedance: 100Ω ± 15%	
17	Performance	Patch Cords which will give guaranteed higher bandwidth will be preferred.	
18	Regulatory Compliances	OEM should be an ISO9001, ISO 14001 and ISO 45001 should have its Manufacturing units, Components and Finished Goods Warehouse in India. All Related documents to be submitted.	
		Shall comply to ISO 22196-2011, IEC 71034-2, IEC 60754-2 Standard	

		OEM offered must be in India / SAARC for at-least 10 years or more. Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	
		The Proposed OEM should be a member of BICSI and should have a CDCP and a PMI-PMP / RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	

Technical Specification of CAT6A Face Plate (1,2 & 4 Port)

S.No.	Parameter	Specification	Complied (Yes/No)
1	Type	UK Style with Built-in Dust Covers / Shutters on Face Plate for closing ports to prevent from dust entry	
2	Material	Manufactured by incorporating an antibacterial agent (biocide) can suppress the growth of bacteria on the surfaces of products when conditions exist where growth can occur.	
3	Acceptability	Should be able to accept Cat6A, Cat6 and Cat5e information outlets, Modules, Keystones and Adaptors to suit all installation requirements	
4	Approvals	UL 94V-0	
5	No. of plates	2 Plates/Pieces Face Plate for better aesthetic look	
6	Mounting screws	Include mounting screws and Label Holders with Plastic covers	
7	Available	Single/Dual/Quad network faceplate	
8	Dimensions	(H x W x D) 86 x 86 x 14.42 mm	
9	Regulatory Compliances	All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only who is a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
		Compliant to ISO 22196-2011 and RoHS 2 Standards	
		OEM should be an ISO9001, ISO 14001 and ISO 45001 should have its Manufacturing units, Components and Finished Goods Warehouse & R&D labs in India. All Related documents to be submitted.	

Technical Specification of 42U Floor Mount Rack

S.No.	Technical Specification	Complied (Yes/No)
1	42 U Floor Mount Rack with fan	
2	Stationary shelf	
3	PDU 6 Socket 5 Amp	
4	Rack Width and Depth (800 mm x 1000 mm)	
5	Top and bottom cable entry provision	
6	19" mounting angles at front and rear are rescissible	
7	Glass Front Door with Lock	
8	On the top cover, cut out with grills for fan mounting offset	

9	Racks shall be inclusive of all the necessary mounting accessories and hardware complete a required for a complete Installation.	
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Technical Specification of 15U Wall Mount Rack

S.No.	Technical Specification	Complied (Yes/No)
1	15 U Wall Rack with fan	
2	Stationary shelf	
3	PDU 6 Socket 5 Amp	
4	Rack Width and Depth (550 mm x 500 mm)	
5	Top and bottom cable entry provision	
6	19" mounting angles at front and rear are rescissible	
7	Glass Front Door with Lock	
8	On the top cover, cut out with grills for fan mounting offset	
9	Racks shall be inclusive of all the necessary mounting accessories and hardware complete a required for a complete Installation.	

Technical Specification of 9U Wall Mount Rack

S.No.	Technical Specification	Complied (Yes/No)
1	9U Wall Rack with fan	
2	PDU 6 Socket 5 Amp	
3	Rack Width and Depth (550 mm x 500 mm)	
4	Top and bottom cable entry provision	
5	19" mounting angles at front and rear are rescissible	
6	Glass Front Door with Lock	
7	On the top cover, cut out with grills for fan mounting offset	
8	Racks shall be inclusive of all the necessary mounting accessories and hardware complete a required for a complete Installation.	

Technical Specification of 6U Wall Mount Rack

S.No.	Technical Specification	Complied (Yes/No)
1	6U Wall Rack with fan	
2	PDU 6 Socket 5 Amp	
3	Rack Width and Depth (550 mm x 500 mm)	
4	Top and bottom cable entry provision	
5	19" mounting angles at front and rear are rescissible	
6	Glass Front Door with Lock	
7	On the top cover, cut out with grills for fan mounting offset	
8	Racks shall be inclusive of all the necessary mounting accessories and hardware complete a required for a complete Installation.	

24. GAS SUPPRESSION & TOTAL ROOM FLOODING SYSTEM

HT Panel, All panels in substation, Main Hospital Panels, Server/IT Rooms

1. INTENT OF SPECIFICATIONS

This specification is for procurement of total flooding fire suppression system use with NOVEC-1230, clean agent. All requirements outlined in this specification must be completed in their entirety. These requirements, which are in accordance with the items listed in Section 2, combined with good engineering practices, shall be followed in order to produce a safe and effective fire suppression system.

2. GENERAL DESCRIPTION

Fire Suppression Systems shall be used to suppress fires in specific hazards or equipment located where an electrically non-conductive agent is required, where agent cleanup creates a problem, where extinguishing capability with low weight is a factor and where personnel normally occupy the hazard.

Fire Suppression Systems for the following classes of fire:

- Class A: Surface Type Fires—wood or other cellulose-type material
- Class B: Flammable liquids
- Class C: Energized electrical equipment

For hazards beyond the scope described above, consult with OEM and NFPA 2001.

- a) The name of the manufacturer shall appear on all major components
- b) All equipment shall be UL Listed.
- c) All device, components and equipment shall be the products of the same manufacturer, or supplied by the same manufacturer.
- d) All devices, components and equipment shall be new, standard products of the manufacturer's and suitable to perform the functions intended.

3. CODES AND COMPLIANCE

1. The installation, testing and maintenance of the Fire Suppression Systems, employing NOVEC-1230, shall be in accordance with the following codes, standards and regulatory bodies:

- a) NFPA 2001: *Standard for Clean Agent Fire Extinguishing Systems.*
- b) UL 2166: *Standard for Halocarbon Clean Agent Extinguishing System Units*
- c) IS : 15493: *Gaseous Fire Extinguishing System - General Requirements*
- d) IS : 15496 : *Inspection and Maintenance of Gaseous Fire Extinguishing System - Code of Practice*
- e) ANSI B1.20.1 : *Standard for pipe threads, General Purpose, 1992*
- f) NFPA 70 - NEC – *National Electrical Code*
- g) NFPA 72 – *National Fire Alarm Code*
- h) Requirements of the local Authorities Having Jurisdiction (AHJ)

1. The manufacturer shall meet ISO 9001 requirements for the production and distribution of the engineered fire suppression system.

2. All components of the total flooding suppression system shall be the products of the same manufacturer or listed by that manufacturer as compatible with those devices, components and equipment.

4. SYSTEM CRITERIA

The delivery of the FK 1230 (FK-5-1-12) system shall provide for the highest degree of protection and minimum extinguishing time.(As per NFPA 2001)

Sub floor and the ceiling void to be included in the protected volume.

The FK 1230 System to be supplied by the bidder must satisfy the requirement of the Authority having Jurisdiction over the location of the protected area.

The discharge time required to achieve 95% of the minimum concentration for flame extinguishment shall not exceed ten (10) seconds. In accordance with NFPA Standard 2001.

Welded cylinders for agent storage will not be acceptable- nor shall such Seamless cylinders that do not have the approval of Chief Controller of Explosives, Nagpur.

Offer Cylinder shall be seamless type, manufactured and tested in accordance with IS 7285 Standard and approved by PESO for their use.

A total flooding, clean agent fire suppression system, filled with FK 1230, shall be installed to meet a minimum concentration of **4.5 %** for Class C Fire.

- 5. Application. This specification outlines the requirements for an automatic fixed fire suppression system using FK 1230 as the suppression agent. The hazard(s) to be protected are:**

	Hazard	Length	Width	Height (Met.)		
		Met.	Met.	Room Void	Ceiling Void	Floor Void
1						
2						
3						

- 6. Submittals Of Engineered Drawings**

The OEM-authorized Distributor or OEM shall provide all required installation drawings per NFPA 2001.

- 7. Flow Calculation Reports**

The system flow calculations shall be carried out on certified software, suitable for the particular seamless cylinder container being offered for this project. Such System flow calculations carried out for this project shall be further vetted by the OEM for its accuracy, and the only such vetted calculations shall be admissible for approval by the Consultant.

- 8. Installation Drawings**

Four (4) sets of installation drawings for each installed engineered suppression system and one (1) set of the calculation report, owner’s manual and product data sheets shall be submitted to the end-user/owner.

Upon completion of installation and commissioning acceptance, three (3) sets of “As-Built” installation drawings and One (1) set of the calculation report for each installed engineered suppression system shall be given to the owner/end-user for use and reference.

- 9. Operation and Maintenance Manuals**

Three (3) copies of the Operation and Maintenance Manual shall be submitted after complete installation.

- 10. SYSTEM HARDWARE**

Fire Suppression Systems shall include the following components:

- 11. PIPE AND FITTINGS**

Distribution piping, and fittings, shall be installed in accordance with NFPA 2001, approved piping standards and the engineered fire suppression system manufacturer’s requirements.

Pipe : As per ASTM A-106, Sch 40, M. S. Seamless

- 12. ACTUATION HARDWARE**

The Clean Agent cylinder valve assembly shall be actuated using a electric control head (Solenoid) the actuator should have facility of manual actuation also. This electric control head should meet the requirement of NFPA 2001, Sec. 4.3.4.1. This regulation addresses the concern of proper installation of the actuator by providing the necessary supervision within the electric control head.

13. DISTRIBUTION NOZZLES

Discharge nozzles shall be used to disperse the FK1230. The nozzles shall be made of brass with female NPT threads and available in ½" through 2" sizes. Each size shall come in two styles: 180 degree and 360 degree dispersion patterns.

14. Minimum System Limits: Nozzles

- a) Nozzles shall be of a brass, listed and approved for a maximum ceiling height of 16.4 feet (5 m) and a minimum ceiling height of 1 feet (0.31 m).
- b) Nozzle area coverage for both 360-and 180-degree nozzles shall be a maximum of 42.65 ft. x 42.65 ft. square (13 m x 13 m).

15. SEAMLESS CYLINDERS AND VALVE ASSEMBLES

FK 1230 shall be stored in seamless type Cylinders. Welded cylinders are not permitted. Agent cylinder operating pressure shall be at 360 PSIG @ 70°F (24.8 bar gauge @ 21°C). Offer Cylinder shall be manufactured and tested in accordance with IS 7285 Standard and approved by PESO for their use. Clean Agent storage cylinders shall be equipped with safety rupture disc and pressure gauge to display internal pressures. The gauge shall be an integral part of the equipment and shall be color-coded for fast referencing of pressure readings

Cylinder Capacity

- A. 34 liter Cylinder Capacity.
- B. 80 liter Cylinder Capacity.
- C. 120 litter Cylinder Capacity
- D. 140 litter Cylinder Capacity

16. PRESSURE OPERATED CONTROL HEAD

Pressure operated Control Head, should allow for Pressure actuation of Clean Agent storage FK 1230 Cylinders. This should be mounted directly on top of the master or slave cylinder valve.

17. MASTER CYLINDER ADAPTER KIT

The Master Cylinder Adapter Kit, should provide a means to connect the flexible actuation hose to the master & slave cylinder valve assemblies.

18. FLEXIBLE DISCHARGE HOSE & ACTUATION HOSE

19. Flexible Discharge Hose should route FK 1230 agent from the storage cylinders to the discharge piping.

This hose should be connected to the discharge outlet of the Clean Agent Cylinder Valve.

20. The Flexible Actuation Hose, should be usually used in multiple Cylinder Systems

21. MANIFOLD CHECK VALVE

Manifold check valves should be installed at the discharge manifold in a multiple cylinder arrangement to allow removal of any Clean Agent Cylinder from the manifold while still retaining a closed System.

22. MANIFOLD SUPERVISORY SWITCH

Manifold Supervisory Switch, should operate from system pressure upon discharge of FK 1230 gas discharge through piping network.

23. UL LISTED FK 1230 FIRE SUPPRESSION SYSTEM

Sr.	Description	Unit	Qty.
01	CCOE Approved UL Listed Seamless FK 1230 Cylinder and Valve Assembly, 34/80/120/140 Ltrs. capacity, OEM Factory filled with FK 1230 Suppression Liquid, pressurised to 25 / 42 bar.	Nos.	
02	FK 1230 Fire Protection Fluid, OEM Factory Filled	Kg.	
03	UL Listed Electric Control Head operated electrically from the Detection & Control System or locally with a manual lever on the control head.	Nos.	
04	UL Listed Pressure Operated Control Head which allows for pressure actuation slave cylinders and is mounted directly on top of the slave cylinders valve.	Nos.	
05	UL Listed Discharge hose with Manifold Check Valve for above Cylinder's.	Nos.	
06	Master Cylinder Adapter Kit used to actuate the Slave Cylinder.	Nos.	
07	Flexible Actuation Hose	Nos.	
08	UL Listed Manifold Supervisory Switch for indication of discharge of system	Nos.	
09	UL Listed Cylinder Strap	Nos.	
10	UL Listed Brass Male Tee & Elbow	Nos.	
11	Piping, fittings & supports, etc. Pipe (S) : M.S. Seamless To ASTM A-106, SCH. 40	Lot.	

SCHEDULE OF ITEMS

MASTER PLAN

S. No.	MASTER PLAN
I.	33KV SUB-STATION :
1.0	33 KV ISOLATOR PANEL:-
	One (1) No. 33KV 800 Amps. Electrical operated floor rolled draw out type Vacuum Circuit Breaker complete with trip free spring charged closing mechanism, necessary auxiliary relays, control switches, emergency hand trip devices and mechanical ON/ OFF indicator etc. VCB breaker should be tested for Mechanical Endurance M2, Electrical Endurance E2 & Capacitive Switching C2. VCB bottle in fully encapsulated, True close door operation.
	One (1) set of Red/ Green indicating lamp for close and open position.
	One (1) No. Amber indicating lamp for trip indication.
	One (1) No. Clear indicating lamp for trip circuit healthy.
	One (1) No Blue indicating lamp for spring charged.
	One (1) Space heater to prevent absorption of moisture
	Spare Contacts shall be provided on the rear of the panel for BMS integration.
	33 KV ISOLATOR PANEL as described above.
2.0	33 KV H.T MAIN PANEL: (ESS)
	Receiving of 3 Nos. VCB, High Voltage Board at site as per specification, and comprising of the following : Note - Panel should be Internal Arc Type Tested 26.3kA for 1 Sec and Short circuit of panels should be 26.3kA for 3 Sec.
A)	<u>Incoming-</u>
-	One (1) No. 33KV 800 Amps. 26.3kA Electrically operated, floor rolled draw out (EDO) type vacuum circuit breaker complete with trip free spring charged closing mechanism, necessary auxiliary relays, control switches, emergency hand trip devices and mechanical ON/ OFF indicator etc. VCB breaker should be tested for Mechanical Endurance M2, Electrical Endurance E2 & Capacitive Switching C2. VCB bottle in fully encapsulated, True close door operation.
	One (1) set of 33KV indoor surge arrestors suitable for protecting the equipments from lightning and switching surges, complete with mounting arrangement, on all phases. Maximum Let-Through-Voltage / Maximum residual Voltage of the surge arrester should be 33KV (Peak) for 10 KA discharge current of 8/20 micro second wave.
-	One (1) No. Multifunction meter (MFM-1) with RS-485 Port suitable for measurement of voltage, currents, power factor, frequency, Energy (KWH, KVARH KVAH), Power (KW, KVA and KVAR), harmonics and maximum demand indication (EM6400NG, WL5010 or Equivalent from approved make list make).
-	One (1) set of CTs of Dual ratio 300/150/5-5A with metering and protection cores. Metering core shall be of class 0.5 and of 15VA, the core for protection shall be of 15VA and class 5P10.
-	One (1) Set of phase indication lamps with 2Amp SP MCB for protection (Red, Yellow and Blue).

-	One (1) set of Red/ Green indicating lamp for close and open position.
-	One (1) No. amber indicating lamp for auto trip.
-	One (1) No. clear indicating lamp for trip circuit healthy.
-	One (1) blue indicating lamp for spring charged.
-	One (1) strip heater to prevent absorption of moisture.
-	One (1) Set of Multifunctional protection relay with Communication Compatibility with minimum protection 51& 51N .
-	Master Trip Relay (86).
-	Trip circuit supervision relay (95).
-	Over Voltage Relay (59).
-	Under Voltage Relay (27).
-	One (1) set of 33KV/ $\sqrt{3}/110V/ \sqrt{3}$, 100VA burden, Class 1.0 P.Ts drawout type below VCB with suitable back-up protection fuses/ MCBs as required.
-	One (1) No 110VDC, Power Pack of suitable back-up rating for indications and annunciation, as required and as per specifications.
B)	<u>Busbar :</u>
-	800 Amp. Colour coded heat shrinkable PVC sleeved 3P copper busbar of 1500MVA fault rating for 1 sec..
-	Busbar shall be suitable for 26.3 kA for 3 Second and all CT's shall be suitable for 26.3 kA for 1 Second.
C)	<u>Outgoing :</u>
-	Four (4) Nos. outgoing feeder each equipped with the following :-
-	One (1) Nos 33kV, 26.3kA, 800A, Electrically operated, floor rolled draw out (EDO) Type VCB complete with stored energy mechanism for manual operation, three position isolator/ earthing switch with manual operating mechanism & auxillary switch with 6NO+6NC contacts, busbars, interlocking and earth bar etc.as per specifications. Outgoing shall be provided with necessary auxiliary relays, control switches, emergency hand trip devices and mechanical ON/ OFF indicator etc. VCB breaker should be tested for Mechanical Endurance M2, Electrical Endurance E2 & Capacitive Switching C2. VCB bottle in fully encapsuled, True close door operation
-	One (1) set of CTs of Dual ratio 120/60/5+5A with metering and protection cores. Metering core shall be of class 0.5 and of 15VA, the core for protection shall be of 15VA and class 5P10.
-	One (1) No. Digital Ammeter of range (0-200A) with selector Push Button.
-	One (1) set of Red/ Green indicating lamp for close and open position.
-	One (1) No. amber indicating lamp for auto trip.
-	One (1) No. clear indicating lamp for trip circuit healthy.

-	One (1) No. blue indicating lamp for spring charged.
-	One no. 4 window Audio/visual annunciator system complete with hooter, Ack, test & Reset PBs for annunciation of following:-
-	Winding temperature - Alarm
-	Winding temperature - Trip
-	HT breaker - Trip
-	Spare
-	One (1) Set of Multifunctional protection relay with Communication Compatibility with minimum protection 50, 50N, 51&51N .
-	Master Trip Relay (86).
-	Trip circuit supervision relay (95).
-	Including power pack for control circuits.
-	One (1) No 110VDC, Power Pack of suitable back-up rating for indications and annunciation, as required and as per specifications.
	33 KV H.T PANEL as described above.
3.0	Supply of Earth Truck Cable Side suitable for above 33 KV Panels.
II.	H.T. CABLING (33KV) :
	-
1.0	Cable Laying :
	Laying of one number XLPE power cable of 33kV grade of following size direct in ground including excavation, sand cushioning, protective covering and refilling the trench etc. as required.
	Above 120 sq. mm and upto 400 sq. mm
2.0	Laying of one number XLPE power cable of 33 kV grade of following size in the existing RCC/ HUME/ METAL pipe as required.
	Above 120 sq. mm and upto 400 sq. mm
3.0	End Termination (HT) :
3.1	Supplying, Installation, testing and commissioning of Cable jointing (Outdoor Type) of 33 KV grade XLPE insulated armoured cable with suitable cable termination using RAYCHEM/Birla 3M/MECP KITS including all accessories i.e. Sockets, lugs, gland etc as required but without cable box.
a)	1C x 240 Sqmm, 33KV (E) XLPE
b)	1C x 150 Sqmm, 33KV (E) XLPE
4.0	Supply of HT Cable
	Supply of following sizes of 33 KV cables conforming to the data given below:

	Guaranted Technical Particulars for 33 KV Cables
	Conductor :
a.	Core/Size : 3
b.	Material : Aluminium
c.	Shape : Circular
d.	Type : Stranded
	Insulation :
e.	Material : XLPE
	Inner Seath:
f.	Material : PVC(ST1/ST2)
	Type : Extruded
	Armour:
g.	Material : GI
	Type : Flat
	Outher Sheath:
h.	Material : HR PVC
	Type : ST 2
	FRLS : Not required.
	Drum Length : As per Site requirement
i.	1C x 240 Sq.mm XLPE HT cable (Earthed)
i.	1C x 150 Sq.mm XLPE HT cable (Earthed)
5.0	Hume Pipe:
	Supply and installation of following sizes of NP3 class S/S R.C.C. pipes with collars jointing with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including curing, testing of joints etc. Complete in all respect as required (Pipe to be laid 1200 mm below ground).
a)	200 mm dia
b)	250 mm dia
6.0	Supplying and laying of following size DWC HDPE pipe ISI marked along with all accessories like socket, bend, couplers etc. conforming to IS 14930, Part II complete with fitting and cutting, jointing etc..direct in ground (75 cm below ground level) including excavation and refilling the trench but excluding sand cushioning and protective covering etc., complete as required.
a.	160 mm dia (OD-160 mm & ID-135 mm nominal)
b.	200 mm dia (OD-160 mm & ID-135 mm nominal)
7.0	Supply and installation of following sizes of 'A' class GI pipe sleeve for cable run on the structure/entry to the building including providing water tight sealant.
a)	150 mm dia
b)	200 mm dia

III.	SUB STATION SAFETY EQUIPMENT :
1	Supplying and fixing of 900 mm wide checkered insulated matting of suitable thickness, conforming to IS 15652-2006 complete as required.
a)	Suitable for 33kV
2	Supplying & fixing standard shock treatment charts in English & Hindi duly framed and covered with glass.
3	Providing & fixing HT danger notice plate 200 mm x 150 mm made of mild steel atleast 2mm thick & vitreous enameled white on both sides and with inscription in signal red colour with skull & bone on front side as required.
4	Supplying and erection of the following equipment at suitable locations in the substation building as required and as per specifications.
a)	4 1/2 kg DCP fire extinguisher (conforming to IS:2171 with cylinder fully charged).
b)	4 1/2 kg CO2 type fire extinguisher (conforming to IS-2878).
5	Supplying and installing at approved location approved make 5 nos. fire buckets of 24 gauge galvanized steel, painted white inside and red outside and black on the bottom, inscribed with letters "FIRE" in black and gold including stand fabricated out of sheet metal (16 gauge) shade, platform and associated civil works, painting etc as approved by fire authority.
6	Providing 33 KV tested hand gloves.
7	Providing 33 KV insulated grounding rod.
8	Providing first aid box as per IS: 2217.
IV.	TRANSFORMER (Oil type) :
1.0	Design, manufacture, loading, unloading, supply, Supervision of Installation testing and commissioning on location as desired by project manager or as shown in layout plan, of 2500 KVA, oil filled 33/0.433KV, 3 phase, 50 Hz, delta/star connected with additional neutral of LT winding brought out to separate bushing terminal for earthing, oil immersed ONAN cooled, complete with all fittings such as oil conservator, silica gel breather, thermometer, explosion vent, ON LOAD Tap changer with +5% & -15% tappings in steps of 2.5% , diagram & rating plate, oil temperature indicator, winding temperature indicator and buchholtz relay with wiring upto marshalling box, lifting lugs, first filling of oil, and weather proof 33KV HT cable box, LT cable chamber minimum 8mm thick non magnetic gland plate etc. complete as per specification and as per IS:1180 latest amendment upto date. (The transformer shall be subject to all test specified in specification and test certificates shall be produced).The Transformer shall be certified for Level-2 as per IS: 1180 (Latest amendment). Core shall be of prime metal grade CRGO with boltless design.
	Voltage Ratio : Dual Ratio 33/0.433KV
	Vector Group : Dyn11
	Tap Range [ON Load] : +5% to -15% step of 2.5%
	Insulation Class : 'A'

	Tap Range [ON Load] : +5% to -15% step of 2.5%
	Temp rise @ 50 deg C ambient
	In winding by resistance : 45 deg C
	In Oil : 40 deg C
	Impedance : 6.25%
	Terminal arrangement (HV) : 3Rx1Cx150 Sq.mm. cable @ 33kV
	Terminal arrangement (LV) : 4000A Al. Busduct (2500KVA) @ 433V
	RTCC Panel
	RTCC (Remote Tap Changer Control) Panel suitable for Remote Operation of following 33/0.433 KV Transformer complete with all accessories as required.
	Remote Tap Changer Control Panel (RTCC) comprise the following and as per technical specifications:
	SITC of RTCC panel shall be of sheet steel cabinet for indoor installation, floor mounting type. The RTCC panel shall be fabricated out of 14 SWG CRCA sheet, totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket and padlocking arrangement.
	All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of RTCC panel. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panel.
	The following components shall be provided in the RTCC panel :
	- Digital Tap Position Indicating Meter
	- Raise/Lower Push Buttons for Remote Control of OLTC
	- Tap Change in Progress Signal Lamp.
	- Supply on Signal Lamp
	- Local / Remote Control Indicating Lamps
	- Panel illuminating lamp with door switch.
	- Space Heater with Switch and Thermostat.
	- Automatic Voltage Relay with Time Delay Element.
	- Selectors switch for Auto/Manual Operation.
	- Undrilled Gland Plate for Cable entry.
	- Earthing Terminal
	- Lifting Eyes Bolts.
	Control Cabling from RTCC Panel to Transformer.
	Suitable potential free contacts shall be provided.
a)	RTCC Panel for 2500 KVA Transformer as described above.
	2500 KVA (ESS) Transformer and RTCC panel as described above
V.	BUS BAR TRUNKING/ BUS DUCT:

1.0	Design, Manufacturing, supply, installation, testing & commissioning of compact sandwich type, sheet steel enclosed 3 phase & neutral bus duct 415V, 50 Hz. suitable for 50kA fault rating aluminium conductor bus duct including bends, transposition piece expansion joint, all flexible connections (wherever Aluminium conductors are jointed with copper, Bimetalic joints to be used), flexible Bellows adopter box etc. as per specifications and drawings with all accessories, supports and termination of bus duct to Switchgear/ Transformers.
a)	4000A TPN Busduct, 50kA (IP-56) for Outdoor application
b)	2500A TPN Busduct, 50kA (IP-56) for Outdoor application
1.1	Supply, installation, testing & commissioning of End Terminations including Adapter box, Flexible Bellows (in case of Termination on the DG set), Flexible Joints etc with all accessories & supports etc.as required and as per site conditions.
a)	For 4000A TPN Busduct, with Bi-Metalic conductor Flexible Couplings. (At Transformer end)
b)	For 4000A TPN Busduct, with Aluminium conductor Flexible Couplings. (At LT Panel, end)
c)	For 2500A TPN Busduct, with Aluminium conductor Flexible Couplings. (At DG, end)-(IP-65)
d)	For 2500A TPN Busduct, with Bi-Metalic conductor Flexible Couplings. (At Synchronization Panel end)-(IP-65)
e)	For 4000A TPN Busduct, with Bi-Metalic conductor Flexible Couplings. (At DG Syn. Panel end)
VI.	MV SWITCHGEAR PANELS :
	Design, manufacture, supply, installation, testing and commissioning of following Utility panels suitable for 415 V, 3 phase, 4 wire, 50 Hz power distribution system. The panel shall be Indoor, free standing, floor mounting, sheet metal clad, cubicle, dead front, dust and vermin proof type compartmentalised design fabricated out of 2mm thick CRCA sheet steel for Load bearing members and 1.6 mm thick for non-load bearing members, complete with colour coded, heat shrinkable PVC insulated, aluminium bus bars (current density 0.66 Amp/sqmm) and separate earth bus bar of adequate cross section through out the length of the panel. The incoming and outgoing feeders shall be accommodated in a fully segregated, modular multitier arrangement with adequate size and distinct cable alley, bus bar alley/chamber (form-3b Construction). The panel shall be complete with name plate, earthing, numbering, danger plate etc. as required and as per specifications and drawings. The panel shall withstand the fault level of as indicated elsewhere or shown in Single Line Diagrams.
	<u>Important Notes: Common for all Switchboard:</u>
1	The BOQ shall be read inconjunction with general notes, specification and Single Line Diagram (attached for Ref.). Incase of any discrepancy between specification, BOQ and SLD, the same shall be brought to the notice of Client/Consultant before quoting the rates, otherwise stringent condition shall be deemed to have been considered.
2	Fault current wherever mentioned shall be Ics value. (Ics = 100% Icu).
3	All MCCB shall be provided with door interlocked rotary handle with ON/TRIP/OFF position indicator, continious variable thermal magnetic O/C and S/C releases. The MCCB above 250A rating shall be provided with microprocessor based releases.

4	Incoming MCCBs shall be provided with O/C, selective S/C, Instantaneous short circuit protection releases.
5	Outgoing MCCBs shall be provided with O/C, and selective short circuit protection.
6	All feeder doors shall have pad locking arrangement.
7	All TP feeders shall have solid isolable neutral link.
8	All MCCB used in starter feeder shall be suitable for motor duty application.
9	All power contactors including NIC shall be of AC3 duty.
10	All ACB's shall be with micro processor based releases and Breaker Control Switch (BCS) having lost motion device.
11	Incoming ACBs shall be provided with O/C, selective S/C, Instantaneous short circuit and Earth fault protection releases.
12	Outgoing ACBs shall be provided with O/C, and selective short circuit protection.
13	Bus Coupler shall be provided without releases.
14	Spare contacts of ACB/Relays/Contactor etc. shall be wired upto terminal block.
15	All Energy meters are digital type & with RS-485 port for communication.
16	Panel shall be powder coated of approved shade with minimum 60 micron thickness.
17	ACB's/MCCB's in one particular panel shall be of one similar make.
18	Size of Voltmeter / Ammeter for incomer also, 96mm x 96mm flush mounted with shrouded terminal shall be used in the panel.
19	Bus bar chamber shall be kept at top of the all panels.
20	All bus bar shall be insulated with coloured PVC Sleeve i.e. RYB, BK as per colour code.
21	Internal wiring of panel shall be with size 2.5sqmm Flexible Copper Conductor for CT circuit and control wiring with 1.5 sqmm.
22	All Lift Panels transport section should not be more than 1000 mm.
23	In soft starter Vender should supply power contactor with aux. Contactor & All necessary accessories required etc. (As per BOQ & specification)
24	All indicating light shall be LED type.

25	Each vertical section of floor mounted panel shall have independent base frame (75mm x 40mm) size made out of 3 mm sheet steel (LT Panel & DG Panel).
26	All the makes shall be as per approved make list only.
27	Wherever only voltmeter & ammeter are required, the same may be provided in combined meter suitable for both parameter.
28	Space heater shall be provided in each cable alley.
29	All links/drops for ACB/MCCB shall be designed for full rated current of ACB/MCCB rating at same current density of Main Bus Bar.
30	All switchgear used in starter feeder shall be type-2 co-ordinated. Vendor is required to submit manufacturer's type-2 co-ordination chart for the make used.
31	Starters shall be provided with MPCB, suitable for the specified Kw of motor (as per SLD), AC3 power contactors, single phasing preventor, on-off Trip Indication Lamps, Start Stop Push Buttons, Auto Manual selector switch Ammeter with Suitable ratio CTs, suitable nos of NO/NC Auxillary Contacts for Building Automation system and remote control, interlocking with CO sensor system, Fire alarm system etc. as required.
32	Fault rating of RCCB shall be equal to the fault rating of MCBs.
33	Necessary Co-ordination shall be done by the Panel Manufacturer / Vendor with the vendor of "Gas flooding system" for fire protection, for making suitable provisions in the panels, at the Design stage, Manufacturing stage, stage of testing at works & stage of commissioning at site.
34	All LT panels & Distribution Boards shall be provided with TVSS (SPDs). Panel vendor/Manufacturers shall Co-ordinate with SPD Vendor for the suitable provision for the installation for the same (SPDs).
1.0	Main LT Panel:
	Main LT Panel shall Comprise of the following:
a)	Incomings:
-	Four (4) Nos. 4000 Amps, 415 V, 65kA four pole draw out, Electrically operated ACB, with ON/OFF/TRIP circuit healthy/Spring Charged indication lamp and TNC control switch, under voltage & shunt trip release, anti pumping protection microprocessor based O/C, Time Delayed S/C, Instantaneous S/C, E/F protection etc. complete as required for Transformer Supply Feeder.
-	Two (2) Nos. 4000 Amps, 415 V, 65KA, 4 pole drawout type electrically operated ACB with ON/OFF/TRIP/Trip Ckt. healthy/Spring Charged indication lamp, TNC control switch, under voltage & shunt trip release, anti pumping protection, microprocessor based O/C, Time Delayed S/C, Instantaneous S/C, E/F protection etc. complete as required for DG Supply Feeder.
b)	Metering & indication for Transformer Supply incoming breakers:
	Each Breaker shall be provided with :

i)	One(1) No. multifunction meter (MFM-1) with Rs- 485 port suitable for measurement of voltage, current, power factor, frequency, Power (kW, kVA, kVAR), Energy (kWH, KVAH, KVARH) and Harmonics (Schneider EM6400NG or Equivalent from approved make list make).
ii)	One (1) set 3 Nos. CTs of ratio 4000/5A,15VA, Class 1.0 as required.
iii)	One (1) set of 4000/5 A, C.L 1.0, 15VA CTs for input to APFC relay.
iii)	One (1) set of 4000/5 A, C.L 1.0, 15VA, CTs for input to AHF.
iv)	One set (3 Nos) phase indication lamp with backup SP MCB 2Amp..
c)	Protection Relays & Interlocking for transformer breaker:
	Each Transformer breaker to be provided with :
ii)	One (1) Set of Numerical, Multifunctional protection relay suitable for Under voltage (27), overvoltage (59), Trip Circuit supervision (95) and Master trip relay (86) protections.
d)	Metering & Indication For DG supply breakers:
	Each Breaker shall be provided with:-
i)	One(1) No. multifunction meter (MFM-1) with Rs- 485 port suitable for measurement of voltage, current, power factor, frequency, hour run, Power (kW,kVA, kVAR), Energy (kWH, KVAH, KVARH) and Harmonics (EM6400NG or Equivalent from approved make list make).
ii)	One (1) set 3 Nos. CTs of ratio 4000/5A,15VA, Class 1.0 as required.
iii)	One set (3 Nos) phase indication lamp with backup SP MCB 2Amp..
e)	BUS COUPLER:
	Three (3) no. 4000 Amps, 415 V, 65KA, four pole EDO Bus coupler breaker complete with under voltage and shunt trip release, anti pumping protection, ON/OFF/ indication etc. to be interlocked with the incomers to allow closing of breakers in such a way that either transformer or DG Sets supply can be fed to the buses in all operating condition and necessary interlocking can be achieved as per approved SLD.
f)	BUS BARS:
	Five sections of 5000Amp. 50kA, TPN, Aluminium Bus bar with colour coded, heat shrinkable sleeves. (with 100% neutral). Separate earth Bus of 65 x 8 mm Aluminium shall be provided.
g)	Outgoing:
	Each outgoing feeder shall be provided with ON/OFF/Trip indication lamps. The Number of outgoing feeders shall be as follows. No energy meters shall be provided in spare feeders.
i)	Three (3) Nos. 1600A, 65KA, TPN, MDO, ACB (for Hybrid panel, without Energy Meter).
ii)	Two (2) Nos. 2500 A, 4P EDO, ACB.
iii)	Three (3) Nos. 2000 A, 4P EDO, ACB.
iv)	Three (3) Nos. 1000 A, 4P EDO, ACB

v)	Two (2) Nos. 800 A, 4P EDO, ACB
vi)	Five (5) Nos. 630A, 4P, MCCB.
vii)	Ten (10) Nos. 400 A, 4P MCCB.
viii)	Two (2) Nos. 315A, 4P MCCB.
ix)	Five (5) Nos. 250A, 4P MCCB.
x)	Three (3) Nos. 200 A,4P, MCCB.
xi)	One (1) Nos. 160 A,4P, MCCB.
xii)	Two (2) Nos. 100 A,4P, MCCB.
2.0	Hybrid Panels 500AHF+600kVAR # Complies with IS-16636 with valid Type test
	Design, fabrication, loading, unloading at store, supply, Installation, Testing & Commissioning of 600 KVAR capacitor bank and panel consisting of 100 KVAR, 50KVAR, 25KVAR, capacitor unit in tier formation; housed in an integrated cubicle type, indoor type automatic switching 'ON' and 'OFF' control panel with dust and vermin proof hinged and lockable doors complete with interconnections, bonding to earth and painting (suitable for 433Volts, 3 phase 50 Hz supply system).
	Panel shall be compartmentalized with liberally designed fabrication space for ventilating the capacitor unit to limit the temperature rise as per relevant IS Standard.
a)	The fabrication of panel shall be done with the provision of 500kVAR with extended bus bar.
b)	The sequencing of relay shall be FIRST IN FIRST OUT with time delay.
	Incoming (1 No.):
	One (1) No. 1600A, 50KA, TPN, MDO, ACB, (1250A, 50KA, 4P ACB) is already included in Main LT Panel as O/G to Capacitor Panel. Hence, not to be included here).
	Metering & Indication:
	One (1) No. 0-500V volts digital Voltmeter with 3 way 'ON' and 'OFF' selector switch.
	One (1) No. (0-1600A) Digital Ammeter with ammeter selector switch and 630/5A, CL-1, 15VA CTs.
	Phase indication lamps each backed up with 2 Amps MCB and ON/OFF switch.
	Auto/Manual mode indicating lamp.
	Power factor compensating relay (including power factor meter) in 10 steps for automatic cut off or add on capacitor units to keep the power factor at 0.95 with variation of loads. All associated auxiliary contactors / relays/ timer/ auto manual selector switches to be provided.
	Bus Bars:
	1500A, TPN aluminium, colour coded bus bars suitable for 415V, 50Hz. (after deration)

	Outgoing :
	Each outgoing Capacitor unit shall be provided with the followings :-
	Analogue Ammeter with 1 No. CT of suitable ratio.
	Lower Limit (in RED colour) & Upper Limit (in Green Colour) shall be marked on the dial of the Ammeter.
	100, 50, 25 KVAR capacitor units
-	Hybrid Panels 500AHF+600 kVAR Panel described as above
	# 800A AHF is used for Hospital Block Panel-1
	## 600A AHF is used for Hospital block panel-2
	### 60A AHF is used for R&D / Acadmic block Panel
3.0	AMF CUM DG SYNCHRONIZATION Panel:
	AMF CUM DG SYNCHRONIZATION Panel shall Comprise of the following:
a)	Incomings:
-	Four (4) Nos. 2000 Amps, 415 V, 65kA four pole draw out, Electrically operated ACB, with ON/OFF/TRIP circuit healthy/Spring Charged indication lamp and TNC control switch, under voltage & shunt trip release, anti pumping protection microprocessor based O/C, Time Delayed S/C, Instantaneous S/C, E/F protection etc. complete as required for Transformer Supply Feeder.
b)	Metering & indication for DG Supply incoming breakers:
	Each Breaker shall be provided with :
i)	One(1) No. multifuction meter (MFM-1) with Rs- 485 port suitable for measurement of voltage, current, power factor, frequency, Power (kW, kVA, kVAR), Energy (kWH, KVAH, KVARH) and Harmonics (Schneider EM6400NG or Equivalent from approved make list make).
ii)	One (1) set 3 Nos. CTs of ratio 2000/5A,15VA, Class 1.0 as required.
iv)	One set (3 Nos) phase indication lamp with backup SP MCB 2Amp..
e)	BUS COUPLER:
	One (1) no. 4000 Amps, 415 V, 65KA, four pole EDO Bus coupler breaker complete with under voltage and shunt trip release, anti pumping protection, ON/OFF/ indication etc. to be interlocked with the incommers to allow closing of breakers in such a way that either transformer or DG Sets supply can be fed to the buses in all operating condition and necessary interlocking can be achieved as per approved SLD.
f)	BUS BARS:
	Five sections of 5000Amp., 65kA, TPN, Aluminium Bus bar with colour coded, heat shrinkable sleeves. (with 100% neutral). Separate earth Bus of 65 x 8 mm Aluminium shall be provided.
g)	Outgoing:
	Each outgoing feeder shall be provided with ON/OFF/Trip indication lamps. The Number of outgoing feeders shall be as follows. No energy meters shall be provided in spare feeders.

	Four (4) Nos. 4000 A, 4P EDO, ACB.
4.0	Feeder Piller-1:- (Outdoor)
	Incomer :
	1 Nos. 100A 4P, MCCB (35KA) with 3-phase energy meter
	1 No. 24 Hr. PHOTO CHROMATIC TIME SWITCH
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	150A TPN Al. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 16kA breaking capacity.
-	5 Nos. 40A TPN MCB.
9.0	FIRE FIGHTING ROOM PANEL
	Incomer :
	One (1) no. 400A TPN MCCB (50KA) with 3-phase energy meter
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 400A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	500A TPN Al. Busbar of short circuit withstand capacity 50kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders (MCCB) shall be of 35kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
-	2 Nos. 250A 4P MCCB with star/Delta starter for 100HP load
-	1 Nos. 250A TPN MCB
-	2 Nos. 40A TPN MCB with star/Delta starter for 10HP load
-	1 Nos. 40A TPN MCB
10.0	AC PLANT ROOM PANEL (HVAC Panel)
	Incomer :

	2 Nos. 2000A 4P, EDO ACB (50KA) with 3-phase energy meter
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 2000A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Bus Coupler
	One(1) No. 2000A, 4-pole, MCCB (microprocessor based with all releases) (50kA) with ON/OFF indication.
	Busbar :
	2500A TPN Al. Busbar of short circuit withstand capacity 50kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 50kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
-	7 Nos. 630A 4P MCCB.
-	2 Nos. 315A 4P MCCB.
-	2 Nos. 200A 4P MCCB.
-	2 Nos. 160A 4P MCCB.
-	9 Nos. 100A 4P MCCB.
-	7 Nos. 63A 4P MCCB.
-	7 Nos. 40A 4P MCCB.
VIII.	<u>DG SETS AND ALLIED SERVICES (AIR COOLED)</u>
	-
A)	SITC OF DG SETS : (With Canopy)
1.0	Design, fabrication, loading, unloading as directed by Engineer-in-Charge, supply, installation, testing and commissioning of 3 phase 415 volts 50 cycle per second, following 1500 RPM prime duty, radiator cooled Diesel Generator Sets . The engine shall be completed with turbo charger, flywheel to suit flexible coupling with guard, air cleaner, blower fan, heat exchanger, fuel pump, variable speed electronic governor, fuel filter, lub oil filter and pump, primary water circulating pumps, battery charger, 12/24 volt batteries of compatible capacity, MS battery stand and instrument panel comprising of switch with key, lub oil pressure gauge, battery charging voltmeter, safety control for low lub oil pressure with tripping etc. The alternator shall be self excited, self regulated, brushless and continuously rated at 0.8 P.F., 3 phase 415 volts, 50 cycle per second, 4 wire system and shall be provided with static excitation unit.
	Alternator insulation shall be class 'H' suitable to withstand tropical conditions and shall generally comply with latest upto date amendment to IS Code. The overload capacity shall not be less than 110% of rated capacity for 1 hour in every 12 hours. The DG Sets shall be mounted on a fabricated rigid common base frame with anti-vibration mountings to provide 98% vibration isolation. The DG set shall include all accessories, fittings, instruments and standard tool kit complete as per specification and as required including control cabling. The cost shall include providing and fixing adaptor box for busduct termination as required.
a)	1500 KVA DG Set with canopy
B)	EXHAUST PIPING

1.0	Supply, laying of following sizes of MS Piping for Exhaust system as per IS:
	3589 and 1239 (part - I) including providing suitable flanges, reducers at suitable intervals, painting etc. as required as per drawings and specifications.
a)	400mm (NB) MS ERW pipe 6mm thick
b)	250mm (NB) MS ERW pipe 4.85mm thick
2.0	Supply of MS bends of above thickness same as above piping along with necessary hardwares ets.:
a)	400mm dia 90 deg bend
b)	250mm dia 45 deg bend
3.0	Supply of 75mm thick LRB mattress insulation (of 120 Kgs. Per cubic meter density) over the exhaust pipes of following diameter including cladding with aluminum sheet of 26 SWG and covering from outside complete as required suitable for DG exhaust pipe temp. upto 450°C etc. as per specifications (for horizontal pipes).
a)	400mm (NB)
b)	250mm (NB)
c)	Insulation of silencers for 1500 KVA DG Set
4.0	Supply of miscellaneous structural support for horizontal/ vertical exhaust piping including fabrication, hardwares and painting as per specifications.
5.0	Supply & Fixing of SS expansion joints for horizontal/ vertical exhaust pipes as required at site:
a)	400 mm exhaust SS Bellows (200mm long)
6.0	Supply, installation, testing and commissioning of schedule- C class MS piping conforming to IS-1239 for fuel piping complete with all necessary fittings and valves between day oil storage tanks and DG sets/priming motor including jointing of pipes, painting with 2 coats of red oxide and two coats of enamel paint.
a)	25 mm dia
b)	50 mm dia
7.0	Supply, installation, testing and commissioning of suit collection and supply port.
C)	MISCELLANEOUS
1.0	Control Cable:
	Supplying, laying, installation, testing and commissioning of the following sizes of 1.1 KV grade PVC insulated and PVC sheathed copper conductor armoured stranded control cable conforming latest IS complete as required.
a)	2 Core x 2.5 Sq.mm Cable
b)	4 Core x 2.5 Sq.mm Cable
c)	10 Core x 2.5 Sq.mm Cable
2.0	Control Cables termination:

	Supplying of all materials and making terminations of control cable terminations for control cables above item complete with single brass compression glands, copper lugs etc. as required.
a)	2 Core x 2.5 Sq.mm Cable
b)	4 Core x 2.5 Sq.mm Cable
c)	10 Core x 2.5 Sq.mm Cable
IX.	MV CABLES & CABLE TRAYS
1.0	With Sand & Protective Covering
1.1	MV Cable Laying upto 25 sq.mm in Ground
	Laying of One number PVC insulated and PVC sheathed/XLPE power cable of 1.1 KV grade of size not exceeding 25 sq.mm direct in ground including excavation, sand cushioning, protective covering and refelling the trench etc as required.
2.0	MV Cable Laying upto 400 sq.mm in same trench
	Laying of One number additional PVC insulated and PVC sheathed/XLPE power cable of 1.1 KV grade of size exceeding 120 sq.mm but not exceeding 400 sq.mm direct in ground in the same trench in one tier horizontal formation including excavation, sand cushioning, protective covering and refelling the trench etc as required.
3.0	MV Cable Laying upto 25 sq.mm in pipe
	Laying of One number PVC insulated and PVC sheathed/XLPE power cable of 1.1 KV grade of size not exceeding 25 sq.mm in the existing RCC/Hume/Stoneware/Metal pipe as required.
3.1	MV Cable Laying upto 400 sq.mm in pipe
	Laying of One number PVC insulated and PVC sheathed/XLPE power cable of 1.1 KV grade of size exceeding 25 sq.mm but not exceeding 400 sq.mm in the existing RCC/Hume/Stoneware/Metal pipe as required.
4.0	Laying and fixing of one number PVC insulated and PVC sheathed/ XLPE power cable of 1.1 KV grade of following size on cable tray as required.
4.1	Upto 35 sq. mm (clamped with 1mm thick saddle)
4.2	Above 35 sq. mm and up to 95 sq.mm (clamped with 25x3 mm MS Flat clamp)
4.3	Above 95 sq. mm and upto 185 sq. mm (clamped with 25/40x3mm MS flat clamp)
4.4	Above 185 sq. mm and upto 400 sq. mm (clamped with 40x3mm MS flat clamp)
5.0	Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed/ XLPE aluminium conductor cable of 1.1 kV grade as required.
5.1	3½ X 400 sq. mm (82 mm)

5.2	3½ X 300 sq. mm (70 mm)
5.3	3½ X 240 sq. mm (62 mm)
5.4	3½ X 185 sq. mm (57 mm)
5.5	3½ X 150 sq. mm (50 mm)
5.6	3½ X 120 sq. mm (45 mm)
5.7	3½ X 95 sq. mm (45 mm)
5.8	3½ X 70 sq. mm (38 mm)
5.9	3½ X 50 sq. mm (35 mm)
5.10	3½ X 35 sq. mm (32 mm)
5.11	4 X 25 sq. mm (28 mm)
5.12	4 X 16 sq. mm (28 mm)
5.13	4 X 10 sq. mm (25 mm)
5.14	3 X 16 sq. mm (25 mm)
5.15	3 X 10 sq. mm (22 mm)
5.16	1C x 400 Sqmm
5.17	1C x 300 Sqmm (Copper)
5.18	1C x 185 Sqmm (Copper)
5.19	1C x 120 Sqmm (Copper)
6.0	Supply, loading, transportation unloading at site, storages at site, shifting from storage place to site of following sizes of XLPE insulated PVC sheathed, FRLS, Aluminium conductor armoured power cable of 1.1 KV grade conforming to IS amended upto date and as per specifications.
6.1	3.5 C x 400 Sqmm
6.2	3.5 C x 300 Sqmm
6.3	3.5 C x 240 Sqmm
6.4	3.5 C x 185 Sqmm
6.5	3.5 C x 150 Sqmm
6.6	3.5 C x 120 Sqmm
6.7	3.5 C x 95 Sqmm

6.8	3.5 C x 70 Sqmm
6.9	3.5 C x 50 Sqmm
6.10	3.5 C x 35 Sqmm
6.11	4C X 25 sq. mm
6.12	4C X 16 sq. mm
6.13	4C X 10 sq. mm
6.14	4C X 6 sq. mm
6.15	3C x 16 Sqmm
6.16	3C x 10 Sqmm
6.17	3C x 6 Sqmm
6.18	1C x 400 Sqmm
6.19	1C x 300 Sqmm (Copper)
6.20	1C x 185 Sqmm (Copper)
6.21	1C x 120 Sqmm (Copper)
7.0	Supply, installation, testing and commissioning of following sizes of 600V/ 1000V Grade Fire Survival/ Fire Resistance galvanised steel wire Armoured cable int the standard aluminium/ Copper conductor, constructed/ designed as per BS 7846 Cable should be suitable to retain the circuit integrity as per BS 8519 and certified for category 3 for F 120 fire test as per BS 8491 Standard on existing cables tray duct/ humen pipe etc. as required.
7.1	4C x 25 Sqmm
7.2	4C x 16 Sqmm
7.3	4C x 6 Sqmm
7.4	3C x 6 Sqmm
8.0	Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed/ XLPE aluminium conductor cable of 1.1 kV grade as required.
8.1	4C x 25 Sqmm
8.2	4C x 16 Sqmm
8.3	4C x 6 Sqmm
8.4	3C x 6 Sqmm

9.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray (Galvanisation thickness not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
9.1	100 mm width x 50 mm depth x 1.6 mm thickness
9.2	150 mm width x 50 mm depth x 1.6 mm thickness
9.3	300 mm width X 50 mm depth X 1.6 mm thickness
9.4	450 mm width X 50 mm depth X 2.0 mm thickness
9.5	600 mm width X 50 mm depth X 2.0 mm thickness
10.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray " bends " (galvanisation not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
10.1	150 mm width x 50 mm depth x 1.6 mm thickness
10.2	300 mm width X 50 mm depth X 1.6 mm thickness
10.3	450 mm width X 50 mm depth X 2.0 mm thickness
10.4	600 mm width X 50 mm depth X 2.0 mm thickness
11.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray " Tee " (galvanisation not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
11.1	150 mm width x 50 mm depth x 1.6 mm thickness
11.2	300 mm width X 50 mm depth X 1.6 mm thickness
11.3	450 mm width X 50 mm depth X 2.0 mm thickness
11.4	600 mm width X 50 mm depth X 2.0 mm thickness
12.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray " Cross member " (galvanisation not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
12.1	150 mm width x 50 mm depth x 1.6 mm thickness
12.2	300 mm width X 50 mm depth X 1.6 mm thickness

12.3	450 mm width X 50 mm depth X 2.0 mm thickness
12.4	600 mm width X 50 mm depth X 2.0 mm thickness
13.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray " Reducer " (galvanisation not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
13.1	150 mm width x 50 mm depth x 1.6 mm thickness
13.2	300 mm width X 50 mm depth X 1.6 mm thickness
13.3	450 mm width X 50 mm depth X 2.0 mm thickness
13.4	600 mm width X 50 mm depth X 2.0 mm thickness
14.0	Supply, loading, transportation unloading at site, storages at site, shifting from storage place to site of following sizes of XLPE insulated PVC sheathed, FRLS, Copper conductor armoured power Cable of 1.1 KV grade conforming to IS 7098 amended upto date.
14.1	1C x 300 Sqmm
14.2	1C x 185 Sqmm
14.3	1C x 120 Sqmm
15.0	Cable end termination with brass double compression gland and copper lugs for following size of XLPE insulated and PVC sheathed copper conductor cable of 1.1kV grade as required.
15.1	1C x 300 Sqmm
15.2	1C x 185 Sqmm
15.3	1C x 120 Sqmm
X.	EARTHING & LIGHTNING PROTECTION SYSTEM
1.0	EARTHING
1.1	Earthing with G.I. earth pipe 4.5 mtr long, 40 mm dia including accessories and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc. with charcoal/ coke and salt as required.

1.2	Earthing with G.I. earth plate 600mm x 600mm x 6mm thick including accessories and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 meter long etc. with charcoal/ coke and salt as required.
1.3	Earthing with copper earth plate 600mm x 600mm x 3mm thick including accessories and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 meter long etc. with charcoal/ coke and salt as required.
2.0 LIGHTNING CONDUCTOR	
ROOF	
1	Roof Conductor of Diameter Ø- 8 mm, Cross-section- 50 mm ² , of Material- AlMgSi & Complied as per Standard EN 62561-2.,
2	Conductor holder for Parapet wall/Side wall of Material-StSt, for Rd 8-10mm & Fl 20mm, Height 20mm & Complied as per Standard EN 62561-4. With accessories Screw and Gtty, Material SS (M5 x 50mm).
3	Conductor holder for flat roofs with concrete block-C35/45 with dubble conductor holder - Rd 8 mm fixed, Dimension - 141 x 86 x 70mm.
4	Lord Glue adhesive
5	LORD dispenser Cartreige for applying the Glue.
6	Angled Air-termination Rods having total length- 1000 mm, material- Al & diameter of - Ø 10 mm. The air-termination rod is fixed at the metal support structure of the PV modules by two saddle clamps.
7	Air-termination rod having length- 1000 mm , of Material- AlMgSi, of Diameter Ø 10 mm, chamfered on both ends, & Complied as per Standard EN 62561-2.
8	FS clamp according to EN 62561-1, for connecting air-termination tips Rd 10 mm to two round conductors. With plate and anti-rotation protection, for longitudinal or cross connection.
9	Air-termination rod having length- 2000 mm , of Material- AlMgSi, of Diameter Ø 16 / 10 mm, chamfered on both ends, & Complied as per Standard EN 62561-2. (Note: Terminal Height can be changed as per actual design & site conditions).
10	Air-termination rod clamps for connecting air-termination rods with one or two conductors. Material of clamp Al, with clamping range of air-termination rod 16 mm and Clamping range of conductor Rd 2x 8-10 mm, & Complied as per Standard EN 62561-1.,
11	Clamp to connect Air termination rod on Side Wall, Material - StSt, clamping range of air termination rod- Rd 10-16mm
12	Universal Connector of Material - StSt, with T connector, clamping range - 8mm, with truss head screw M10x35mm & Complied as per Standard EN 62561-1.
13	Expansion Piece for temperature-related length compensation of longer conductors, Material- Al, Dia- 8 mm.
14	MV Clamps (Multipurpose connecting clamp) of Material- Al , with clamping range Rd 8-10 mm, & Complied as per Standard EN 62561-1.
15	Round Conductor of Diameter Ø- 8 mm, Cross-section- 50 mm ² , of Material- AlMgSi & Complied as per Standard EN 62561-2.,

16	Conductor holder for Parapet wall/Side wall of Material-StSt, for Rd 8-10mm & Fl 20mm, Height 20mm & Complied as per Standard EN 62561-4. With accessories Screw and Gtty, Material SS (M5 x 50mm).
17	UNI Disconnecting Clamps with intermediate plate for round and flat conductor of Material-StSt, Material thickness- 2.5 mm, with clamping range- Rd / Fl 8-10 / 30 mm, & Complied as per Standard EN 62561-1.,
18	Lightning Strike Counter for recording the number of lightning strikes. Outdoor installation applicable with IP67. Compatible for mounting on round and flat conductor. Clamping range Rd 8-27mm, Clamping range Fl max. 40 mm. Max. impulse discharge current counted (Iimp max) - 100kA.
19	GI flat (32x6mm) Strip having width- 32mm, thickness- 6mm
20	GI Strip holder of material - St/tZn, having height - 10mm. Suitable for 32 x 6 mm
EARTHING	
21	Copper bonded rod with Low carbon steel, high tensile strength with min 250 microns of copper plating, UL listed Diameter- 17.2 mm, Length- 3 meters, Material- Copper Bonded, Coating thickness- 250 microns, min, Approvals- Tested acc. IEC / EN 62561-2, UL 467.,
22	DEHNterra 20 kg bag backfilled compound, - Material Carbon based backfill/earthing compound, Fulgurite formation test at direct lightning (10/350 μ s), lightning long duration test at- 100C No fulgurites/Pass, Environmentally Friendly ROHS certified, Resistivity- <0.12 Ω M, Complying Standard- IEC 62561-7, Testing Approvals Certified from- NABL accredited Laboratories.
23	StSt 316 grade Big clamp to terminate the load on earth electrode. Dimension- 160x60x3 mm.,
24	Poly plastic pit cover of material- Polymer Body & Cover, Product Code- HEP, Dimensions- 300 mm (L) x 300 mm (W) X 260 mm (H), Weight 2.5 kg (5.50 LBS).,
25.0	Supply, installation, testing and commissioning of following sizes of GI/ Copper strip/wire clamped to walls, cable trays, bus ducts, cables in recess or surface etc for equipment/ System earthing complete as required including inter connection between length at joints, all fixing accessories such as Earth bar, saddles, clamps, lugs etc and other fixing hardware material as required for proper installation.
25.1	G.I. Earthing Strip/Wire:
a)	65 x 10 mm strip
b)	50 x 6 mm strip
c)	25 x 3 mm strip
d)	8 SWG wire
25.2	CU. Earthing Strip/Wire:
a)	50 x 6 mm strip
b)	25 x 3 mm strip
XI.	AUTOMATIC FIRE DETECTION AND SUPPRESSION SYSTEM WITH NOVEC 1230 GAS

1.0	Supply, fixing, testing and commissioning of automatic Linear pneumatic Tube Detection based Clean Agent System for Electrical Panels (Linear Pnuematic Heat Detection Tube Panel Protection System), consisting of the Mentioned components.
a.	2kg capacity FK-5-1-12 with UL approved non ferrous Seamless Cylinder, DLP Assembly with automatic valve, push in connector for tube, UL approved 2 Kilogram FK-5-1-12 Gas ref NFPA 2001 FK-5-1-12 , mounting bracket, End of Line adopter, Pressure guage and UL approved low pressure switch for monitoring system activation.
b.	4kg capacity FK-5-1-12 with UL approved non ferrous Seamless Cylinder, DLP Assembly with automatic valve, push in connector for tube, UL approved 4 Kilogram FK-5-1-12 Gas ref NFPA 2001 FK-5-1-12 , mounting bracket, End of Line adopter, Pressure guage and UL approved low pressure switch for monitoring system activation.
c.	Linear pneumatic heat Detection Tube :- UL Listed Heat detection Tube, 4mm ID, 6mm OD, detection temprature less than 175 Deg celcius, mutlilayer, Water Absorbtion ≤ 1.5% @ 20oC and 50% RH as tested per ISO62 with fittings and supports.
d.	Master Control Unit for controlling each system, complete with pressure switches, buzzers and electronic hooters, including all necessary accessories + electrical wiring to make each entire system functional.
e.	Installation & Commissioning
XII. EXTERNAL LIGHTING	
1.0	Installation, testing and commissioning of following Feeder Pillars suitable for 415 V, 3 phase, 4 wire, 50 Hz power distribution system. The panel shall be Weather Proof, suitable for outdoor application, free standing, peadestal mounting, sheet metal clad, cubicle, dead front, dust and vermin proof type compartmentalised design fabricated out of 14 SWG CRCA sheet steel, complete with colour coded, heat shrinkable PVC insulated, aluminium bus bars and separate earth bus bar of adequate cross section through out the length of the panel. The incoming and outgoing feeders shall be accommodated in a fully segregated, modular multitier arrangement with adequate size and distinct cable alley, bus bar alley/chamber. The panel shall be complete with name plate, earthing, numbering, danger plate etc. as required and as per specifications and drawings.
1.1	Feeder Pillar (Weather Proof) :
	Incomer :
	1 Nos. 100A 4P, MCCB (35KA) with 3-phase energy meter
	1 No. 24 Hr. PHOTO CHROMATIC TIME SWITCH
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :

	150A TPN Al. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 16kA breaking capacity.
	5 Nos. 40A TPN MCB.
	<u>POLES</u>
2.0	Supply, Installation, testing and commissioning of 6 meter Heigh hot dip galvanised continuously tapered (bolt fixing type) octagonal Pole with top 70 mm dia and bottom 130 mm dia made of 3 mm thick H T sheet Steel conforming to grade S 355 complete with G I base plate of size 220 mm (L) X 220 mm (B) X 12 mm thickness welded at bottom of pole complete with 4 Nos. 20 mm dia 600 mm long foundation bolts conforming to EN 8 grade, inbuilt/ Vandal resistance, weathproof electrical junction box having terminal block, MCB etc mounted on bakelite sheet for looping in /looping out of cables, with flush door having locking arrangement, earthing arrangement (at atleast 0.5 m height) and mounted on RCC foundation of size 500 mm x 500 mm x 1200 mm in ground and 200 mm above ground level with foundation bolt duly embeded before casting and supply and embedding of suitable size HDPE pipe sleeve for cable entry. complete including erection of Pole complete in all respect as per specification as reqd.
3.0	Supply, Installation, testing and commissioning of 1 Meter long Double arm bracket of approved design and shape made up of MS metal with hot dip galvanised suitable for pole top of 70mm dia complete with fixing arrangement as required (As per GFC drawing).
4.0	Supply, Installation, testing and commissioning of 1 Meter long Single arm bracket of approved design and shape made up of MS metal with hot dip galvanised suitable for pole top of 70mm dia complete with fixing arrangement as required (As per GFC drawing)
	LIGHTING FIXTURE (shall beas per lighting schedule & GFC Drawings)
5.0	Supplying and laying of following size DWC HDPE pipe ISI marked along with all accessories like socket, bend, couplers etc. conforming to IS 14930, Part II complete with fitting and cutting, jointing etc.. direct in ground (75 cm below ground level) including excavation and refilling the trench but excluding sand cushioning and protective covering etc., complete as required.
a.	160 mm dia (OD-160 mm & ID-135 mm nominal)
b.	200 mm dia (OD-160 mm & ID-135 mm nominal)

XIV.	SOLAR PHOTO VOLTAIC POWER GENERATION SYSTEM:
1.0	<p>Supply, Installation, Testing and Commissioning of ongrid Solar Photovoltaic Power Plant conforming to MNRE specifications as amended, consisting of Mono/ Poly Crystalline silicon solar cells, net metering facility, necessary protections, earthing, mounted on Aluminium/ GI structure of suitable strength with following components complete as required:-</p> <p>a) Solar Photovoltaic Module of capacity 50 kWp, manufactured in India, conforming to IS 14286/ IEC61215, IS/IEC 61730-Part-1, IS/IEC 61730-Part-2. Solar Photovoltaic Module conversion efficiency shall not be less than 16.5%. PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.</p> <p>b) Power Conditioning Unit (PCU) of 350-800 VDC Input voltage range and 400V AC, three phase, 4 wire, 50Hz +/- 2.5 Hz, output voltage suitable to generate AC Power with efficiency not less than 97%, total harmonic distortion less than 3% and suitable for ambient temperature from 0 to 50 degree C. The PCU shall adjust the voltage and frequency level to suit the Grid Voltage Frequency.</p> <p>c) Data Monitoring System complete with accessories.</p> <p>d) Fixing of Array junction box & Main junction box with IP65 protection and termination arrangement for incoming and outgoing cable along with glands, lugs and other accessories etc. as required.</p> <p>e) Lightning and surge voltage protection.</p> <p>f) Connections & Interconnections by supplying & fixing required size XLPE insulated copper conductor 1.1 kV grade armoured power and control cables between solar modules, main power cable to grids supply PCU unit along with supplying & fixing of necessary channel/ conduit lugs and other accessories etc.as required.</p>

HOSPITAL BLOCK

Item No.	Description Of Item
A.	SUB HEAD - I : POINT WIRING & ACCESSORIES
	WIRING IN MS CONDUIT
1.0	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable etc. as required.
a.	Group C
2.0	Wiring for group controlled (looped) light point/ fan point/ exhaust fan point/ call bell point (without independent switch etc.) with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed steel conduit, and earthing the point with 1.5 sq.mm. FRLS PVC insulated copper conductor single core cable etc as required.
a.	Group C
3.0	Wiring for twin control light point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed steel conduit, 2 Way modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FRLS PVC insulated copper conductor single core cable etc as required.
4.0	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit alongwith 1 No. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.
5.0	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit alongwith 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.
6.0	Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed steel conduit as required.
	FOR LIGHTING CIRCUIT/ SUB MAIN WIRING
a.	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire (For Light Circuit)
b.	2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire (For 6 Amp Points-UPS)

c.	2 X 6 sq. mm + 1 X 6 sq. mm earth wire
d.	4 X 2.5 sq. mm + 2 X 2.5 sq. mm earth wire
e.	4 X 6 sq. mm + 2 X 6 sq. mm earth wire
f.	4 X 10 sq. mm + 2 X 6 sq. mm earth wire
g.	4 X 16 sq. mm + 2 X 6 sq. mm earth wire
7.0	Supplying and drawing following sizes of FRLS PVC insulated copper conductor, single core cable in the existing surface/ recessed steel/ PVC conduit as required.
a.	3 x 1.5 sq. mm
b.	6 x 1.5 sq. mm
c.	9 x 1.5 sq. mm
8.0	Supplying and fixing of following sizes of steel conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.
a.	20 mm dia
b.	25 mm dia
9.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections etc. as required.
10.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 5/6 A & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. as required.
11.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 Nos 3 pin 5/6 amps modular socket outlet and One No 16 amps modular switch , connection etc. as required. (For light plugs to be used in non residential buildings).
12.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing of 2 Nos 6 pin 5/6 & 15/16 amps modular socket outlet and 15/16 amps modular switch , connection etc. as required.
13.0	# Number of sockets in ICU bed head are: 1. Four number 16A socket. 2. Four number 6A. 3. Two number 6A (for UPS). # Number of sockets in IPD bed head are: 1. Four number 16A socket. 2. Four number 6A. 3. Two number 6A (for UPS).
B.	SUB HEAD - II : MV DISTRIBUTION BOARDS
1.0	MCB DISTRIBUTION BOARDS

1.1	Supplying and fixing following way, single pole and neutral, sheet steel, MCB distribution board, 240 volts, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/RCCB/Isolator)
a.	8 way, Double door
1.2	Supplying and fixing following way, horizontal type three pole and neutral, sheet steel, MCB distribution board , 415 volts, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/ RCCB/ Isolator)
a.	6 way (4 + 18), Double door
b.	8 way (4 + 24), Double door
1.3	Supplying and fixing 5 A to 32 A rating, 240/415 V, 10 kA, "C" curve, miniature circuit breaker suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a.	Single pole
b.	Triple pole
1.4	Supplying and fixing following rating, double pole, (single phase and neutral), 240 V, residual current circuit breaker (RCCB), having a sensitivity current 30mA in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a.	40 A
b.	63 A
1.5	Supplying and fixing TP sheet steel enclosure on surface/ recess along with 16/25/32 A , 415 V "C" curve TP MCB and complete with connections, testing and commissioning etc. as required.
1.6	Supplying and fixing 20 amps, 240 volts, SPN industrial type, socket outlet, with 2 pole and earth, metal enclosed plug top alongwith 20 amps "C" curve, SP MCB, in sheet steel enclosure, on surface or in recess, with chained metal cover for the socket out let and complete with connections, testing and commissioning etc. as required.
1.7	Supplying and fixing 30 A, 415 V, TPN Industrial type socket outlet, with 4 pole and earth, metal enclosed plug top alongwith 30 A, "C" curve, TPMCB, in sheet steel enclosure, on surface or in recess, with chained metal cover for the socket out let and complete with connections, testing and commissioning etc. as required.
1.8	Supplying and fixing Cable End Box (Loose Wire Box)(IP 43) suitable for following single pole and neutral, sheet steel, MCB distribution board, 240 V, on surface/recess, complete with testing and commissioning etc. as required.
a.	For 8 way, Double door SPN MCBDB

1.9	Supplying and fixing Cable End Box (Loose Wire Box)(IP 43) suitable for following triple pole and neutral, sheet steel, MCB distribution board, 415 V, on surface/recess, complete with testing and commissioning etc. as required.
a.	For 6 way, Double door TPN MCBDB
b.	For 8 way, Double door TPN MCBDB
1.10	Supplying and fixing following rating, 'C' series, four pole, 415 volts, MCB in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a.	40 amps
b.	63 amps
1.11	Supplying and fixing following rating, 'C' series, Double pole, 240 volts, RCBO (30mA,10KA) in the existing MCB DB complete with connections, testing and commissioning etc. as required. (SPN DB Incomer)
a.	40 amps
C.	SUB HEAD - III : LIGHT FIXTURES & FAN (Shall be as per Attached Lighting Schedule & GFC Drawings)
D.	SUB HEAD - IV : STRUCTURED CABLING (PASSIVE), DATA, IPABX SYSTEM
	SUB HEAD-I STRUCTURED CABLING (PASSIVE)
1.0	Supply, Installation, Testing & Commissioning of armoured 06 Core Singlemode (OS2) 9/125 Fiber Cable, ITU G.652.D, G.657A1, Outdoor Corrugated ECCS Armor, HDPE (UV) Sheathing, Theoxotropic gel filled OFC cable with 2 Nos steel wire embedded in side sheathing as strengthening member for switch connectivity. Cable should be ROHS compliant and as per ANSI/TIA-568.3-D, Telcordia GR-20, IEC 60794-2/60794-3-10, ISO/IEC 11801, ISO/IEC 24702 complete on surface / recess / in existing pipe / open duct complete etc as required.
2.0	Supply, Installation, Testing & Commissioning of 6F 1U x 19" LIU Loaded with Singlemode OS2 LC Adapters & LC Type LSZH Pigtails should meet IEC 61034-1 ,IEC-60332-1, IEC-60754-1, Insertion loss <= 0.35 dB, Return Loss >= 50, Attenuation: 1310/1550 : 0.3/0.2 dB/KM, Repeatability: <= 0.2DB 1000 times mating cycles along with Spilce tray, cable holder and 4 nos of cable entry exist point with rubber gurment along with the LIU, SPCC Powder Coated, 2-Cut Out type, 1U, RoHS Complied, Meets ANSI/TIA 568.3-D. etc complete as required.
3.0	Supply, Installation, Testing & Commissioning of 24F 1U x 19" LIU Loaded with Singlemode OS2 LC Adapters & LC Type LSZH Pigtails should meet IEC 61034-1 ,IEC-60332-1, IEC-60754-1, Insertion loss <= 0.35 dB, Return Loss >= 50, Attenuation: 1310/1550 : 0.3/0.2 dB/KM, Repeatability: <= 0.2DB 1000 times mating cycles along with Spilce tray, cable holder and 4 nos of cable entry exist point with rubber gurment along with the LIU, SPCC Powder Coated, 2-Cut Out type, 1U, RoHS Complied, Meets ANSI/TIA 568.3-D. etc complete as required.

4.0	Supply, Installation, Testing & Commissioning of LC-LC 9/125µm OS2 Singlemode Round Cord duplex, LSZH fiber patch cord having a protective layer of metal braiding for LIU to switch connectivity. Patch Cord should have Blue Jacket with 1000 time mating cycle complete etc as required.
5.0	Supply, Installation, Testing & Commissioning of Category 6A U/UTP LSZH Cable, Flame Rating IEC 60332-1, 23 AWG solid copper conductors in accordance to TIA/EIA 568.2-D (Category 6) & ISO/IEC 11801 2nd ed(Class Ea), ETL 04-Connector Channel Verified with MTPL, tested @600 Mhz or more, with HDPE insulation of individual conductor and over all Dia of 5.9 ± 0.3 mm with Cross-filler and cable shall not have any kind of Non Metallic Barrier Tape or Metallic Shield inside for Connectivity of Hub room to End Point on surface / recess / in existing pipe / open duct complete etc as required.
6.0	Supply, Installation, Testing & Commissioning of Category 6A RJ45 Unshielded Modular Jack, Keystone information outlet (I/O) in accordance with ANSI/TIA 568.2-D, IEC 60603-7-4 2nd Edition, ISO/IEC 11801, ROHS Compliant. The I/O should have minimum 750 mating cycle and 200 insertion cycle and ETL 04-Connector Channel Verified with MTPL, tested @ 600Mhz for Data, Voice, CCTV & Wi-Fi at Field End complete etc as required.
7.0	Supply, Installation, Testing & Commissioning of Stagcred 24 Port Unshielded, Loaded with Category 6A RJ45 Unshielded Modular Jack, Keystone information outlet (I/O) in accordance with ANSI/TIA 568.2-D, IEC 60603-7-4 2nd Edition, ISO/IEC 11801, ROHS Compliant. The I/O should have minimum 750 mating cycle and 200 insertion cycle and ETL 04-Connector Channel Verified, 1U height, Black with integrated cable support bar, clear label marks and earthing plug for UTP cable termination at rack end complete etc as required.
8.0	Supply, Installation, Testing & Commissioning of Category 6A RJ45 Unshielded LSZH Patch Cord as per ANSI/TIA/EIA 568.2-D and ETL 04-Connector Channel Verified, ROHS Compliant, 24AWG Patch Cord, Diameter 5.9 ± 0.03 mm, 1 Meter, Operating Temperature -10 Deg C to +60 Deg C. patch cord 1 Mtr for Data at Rack Side for Switch to Jack Panel Connectivity complete etc as required.
9.0	Supply, Installation, Testing & Commissioning of Category 6A RJ45 Unshielded LSZH Patch Cord as per ANSI/TIA/EIA 568.2-D and ETL 04-Connector Channel Verified, ROHS Compliant, 24AWG Patch Cord, Diameter 5.9 ± 0.03mm, 2 Meter, Operating Temperature -10 Deg C. to +60 Deg C. patch cord 2 Mtr for Data at User Side for I/O to Computer Connectivity complete etc as required.
10.0	Supply, Installation, Testing & Commissioning of 1, 2, and 4 Port face plate, British Style with Shutter, 2 Plate system clear finish with transparent labelling, ABS-UL94-V0, ROHS Compliant, in accorandce with standards like ANSI/TIA-568.2-D, ISO/IEC 11801:2002 & ISO/IEC 60603-7 white for I/O fixing at user side complete etc as required.
11.0	Supply, Installation, Testing & Commissioning of 42U (800x1000) floor mount Networking rack with fans , 2 cable managers , stationary shelf , 2 Nos. of hardware pkts.
12.0	Supply, Installation, Testing & Commissioning of 27U (800x1000)Floor mount Distribution Networking rack with fans , 2 cable managers , stationary shelf , 2 Nos. of hardware pkts.

13.0	Supply, Installation, Testing & Commissioning of 15U Wall mount Networking rack with fans , 2 cable managers , stationary shelf , 2 Nos. of hardware pkts.
14.0	Supply, Installation, Testing & Commissioning of Power Distribution Unit with 1.5 Meter long cords & 12 Socket of 5/15 Amp.
15.0	Supply, Installation, Testing & Commissioning of Power Distribution Unit with 1.5 Meter long cords & 06 Socket of 5/15 Amp.
	Total of Sub Head-I
	SUB HEAD-II ACTIVE COMPONENTS
16.0	Supply, Installation, Testing & Commissioning of Firewall with 12 x GE RJ45, 2 x GE SFP slots, Console Port (DB9), 100 VLAN interface, UTM throughput 1500 Mbps, IPS throughput 2500 Mbps, VPN Features: IKEv2, IPSec, SSL, 1.2TP/IPSec, Content Filter, Intrusion Detection & Prevention, Securereporter, Sandboxing, Anti-Malware, Anti-Spam, Managed AP Service, Email Security etc. complete as required.
17.0	Supply, Installation, Testing & Commissioning of Core Switch with 26 x 10G SFP+ ports and 2 x 40G/100G QSP28 Ports with switching capacity of 900 Gbps, forwarding performance of 650 Mpps, Latency <650 ns, dual hot swappable internal power supply, Should have Stacking with upto 6 Switches in a single virtual chassis/stack. Should support min 8 GB internal SDRAM, 32GB internal Flash memory, 32 MB packet Buffer. Should have static routing RIP v1, RIPv2. OSPFv2, DHCP Relay, Policy based routing, BPDU blocking,DHCP82, PIM-SM, PIM-SSM, PIM-DM and VRRPv2 from Day 1. Should support BGPv4, GRE and IS-IS from Day 1. The Switch should be EAL2/NDcPP, FIPS 140-2 certified and should be managed with both On-premise and Cloud based controller without changing it's Software image.
18.0	Supply, Installation, Testing & Commissioning of 24 Port POE Access Switches with switching capacity of 92 Gbps, forwarding performance 68 Mpps, having 24 x 10/100/1000BASE-T PoE (RJ45) with minimum PoE budget of 180W with 2 x Combo Gigabit RJ-45/ SFP ports and 2 x 10G SFP+ uplink ports. Should support min 1GB internal DRAM, 1GB internal Flash memory, 16K MAC address, 4K VLAN, Latency: < 4 μs. Should have Static Routing , IGMPv3, ISSU, PVST+, LACP, Loopback detection, Built-in CPU protection against malicious attacks. It should be RoHS, WEEE certified and EN 55024: 2010,EN 55022,EN 50581,EN 61000-3-2. The Switch should be managed with both On-premise and Cloud based controller without changing it's Software image.
19.0	Supply, Installation, Testing & Commissioning of 10G Stacking Cable for above switches.
20.0	Supply, Installation, Testing & Commissioning of 10G Single Mode SFP+ fiber Modules.
21.0	Supply, Installation, Testing & Commissioning of 1G Single Mode SFP fiber Modules.

<p>22.0</p>	<p>Supply, Installation, Testing & Commissioning of Wireless Controller . It should support Unified Network topology for WLAN & LAN Infrastructure . The Solution should support 802.11ac primarily and should be backward compatible to 802.11n/ac wave 1/ac wave 2. The solution should also support 802.11ax with Guest Portal support, support WIPS, Rouge AP detection, Captive portal based user authentication,IPv6 Support, able to provide insights based on Time to connect, successful connect, coverage, capacity, AP Uptime, Roaming and throughput. able to integrate with various authentication mechanism including the RADIUS servers, able to handle interference and shift the communication on another channel automatically if needed, support Dynamic Packet capture to enhance troubleshooting. It should be scalable to handle around 4000 APs or more in single cluster. Single Dashboard management for both Wireless & Switching devices. Integrated captive portal with credentials management for email, sms, social Login Facebook, Google, Rainbow). The Solution should come along with 5 Enterprise User licenses of Cloud based collaboration tool of same OEM.</p>
<p>23.0</p>	<p>Supply, Installation, Testing & Commissioning of Wireless Indoor Access Point. The AP should support 802.11ax with aggregated throughput of 1.7 Gbps.It should support 1GE + 1GE ports inbuilt with the Access Point.It should support Radio Dynamic Adjustment (RDA) technology, IoT, 16 SSIDs, 512 Clients, 802.11i, WPA2, WPA3, 802.1X. Integrated Omni-directional Antenna with 2 Radios, OFDMA support, BSS Coloring, TWT, built-in application intelligence and analytics, User behavior tracking, Operating temp. 0 to 45 degree.</p>
	<p>SUB HEAD-III IP-PBX SYSTEM</p>
<p>24.0</p>	<p>Supply, Installtion, Testing and Comissioning of Pure IP based Voice solution with 1x PRI Trunk lines (30 Ch) Circuit with CLIP Facility, 215 IP users License, 01 Nos. IP Operator Console, 28 Party Conference, Speed Dial, Music on Hold, Internal/ External ring difference, Call Barring, Call Pickup, TEC should be with GR Number complete as required.</p>
	<p>TOTAL FOR SUB HEAD - IV : STRUCTURED CABLING (PASSIVE), DATA, IPABX SYSTEM, UPS</p>
<p>E.</p>	<p>SUB HEAD - V : CCTV SYSTEM</p>
<p>1.0</p>	<p>Supply, Installation, Testing & Commissioning of armoured 06 Core Singlemode (OS2) 9/125 Fiber Cable, ITU G.652.D, G.657A1, Outdoor Corrugated ECCS Armor, HDPE (UV) Sheathing, Theoxtropic gel filled OFC cable with 2 Nos steel wire embedded in side sheathing as strengthening member for switch connectivity. Cable should be ROHS compliant and as per ANSI/TIA-568.3-D, Telcordia GR-20, IEC 60794-2/60794-3-10, ISO/IEC 11801, ISO/IEC 24702 complete on surface / recess / in existing pipe / open duct complete etc as required.</p>
<p>2.0</p>	<p>Supply, Installation, Testing & Commissioning of 6F 1U x 19" LIU Loaded with Singlemode OS2 LC Adapters & LC Type LSZH Pigtails should meet IEC 61034-1 ,IEC-60332-1, IEC-60754-1, Insertion loss <= 0.35 dB, Return Loss >= 50, Attenuation: 1310/1550 : 0.3/0.2 dB/KM, Repeatability: <= 0.2DB 1000 times mating cycles along with Spilce tray, cable holder and 4 nos of cable entry exist point with rubber gurment along with the LIU, SPCC Powder Coated, 2-Cut Out type, 1U, RoHS Complied, Meets ANSI/TIA 568.3-D. etc complete as required.</p>

3.0	Supply, Installation, Testing & Commissioning of 24F 1U x 19" LIU Loaded with Singlemode OS2 LC Adapters & LC Type LSZH Pigtailed should meet IEC 61034-1 ,IEC-60332-1, IEC-60754-1, Insertion loss <= 0.35 dB, Return Loss >= 50, Attenuation: 1310/1550 : 0.3/0.2 dB/KM, Repeatability: <= 0.2DB 1000 times mating cycles along with Splice tray, cable holder and 4 nos of cable entry exist point with rubber gument along with the LIU, SPCC Powder Coated, 2-Cut Out type, 1U, RoHS Complied, Meets ANSI/TIA 568.3-D. etc complete as required.
4.0	Supply, Installation, Testing & Commissioning of LC-LC 9/125µm OS2 Singlemode Round Cord duplex, LSZH fiber patch cord having a protective layer of metal braiding for LIU to switch connectivity. Patch Cord should have Blue Jacket with 1000 time mating cycle complete etc as required.
5.0	Supply, Installation, Testing & Commissioning of CAT 6 U/UTP LSZH Cable, Flame Rating IEC 60332-1, 23 AWG solid copper conductors in accordance to TIA/EIA 568.2-D (Category 6) & ISO/IEC 11801 2nd ed(Class E), ETL 04-Connector Channel Verified with MTPL, tested @350 Mhz or more, with HDPE insulation of individual conductor and over all Dia of 5.9 ± 0.3 mm with Cross-filler and cable shall not have any kind of Non Metallic Barrier Tape or Metallic Shield inside for Connectivity of Hub room to End Point on surface / recess / in existing pipe / open duct complete etc as required.
6.0	Supply, Installation, Testing & Commissioning of Category 6 RJ45 Unshielded Modular Jack, Keystone information outlet (I/O) in accordance with ANSI/TIA 568.2-D, IEC 60603-7-4 2nd Edition, ISO/IEC 11801, ROHS Compliant. The I/O should have minimum 750 mating cycle and 200 insertion cycle and ETL 04-Connector Channel Verified with MTPL, tested @ 350Mhz for Data, Voice, & Wi-Fi at Field End complete etc as required.
7.0	Supply, Installation, Testing & Commissioning of Staggrd 24 Port Unshielded, Loaded with Category 6 RJ45 Unshielded Modular Jack Panel, Keystone information outlet (I/O) in accordance with ANSI/TIA 568.2-D, IEC 60603-7-4 2nd Edition, ISO/IEC 11801, ROHS Compliant. The I/O should have minimum 750 mating cycle and 200 insertion cycle and ETL 04-Connector Channel Verified, 1U height, Black with integrated cable support bar, clear label marks and earthing plug for UTP cable termination at rack end complete etc as required for CAT6 cable termination at rack end.
8.0	Supply, Installation, Testing & Commissioning of Category 6 RJ45 Unshielded LSZH Patch Cord as per ANSI/TIA/EIA 568.2-D and ETL 04-Connector Channel Verified, ROHS Compliant, 24AWG Patch Cord, Diameter 5.8 ± 0.03 mm, 1 Meter, Operating Temperature -10 Deg C to +60 Deg C. patch cord 1 Mtr for Data at Rack Side for Switch to Jack Panel Connectivity complete etc as required.
9.0	Supply, Installation, Testing & Commissioning of 9/12U Wall mount (600 mm x 600 mm) Networking rack with fans , 2 cable managers , 2 Nos. of hardware pkts.
10.0	Supply, Installation, Testing & Commissioning of Power Distribution Unit with 1.5 Meter long cords & 06 Socket of 5/15 Amp.
11.0	Supply, Installation, Testing & Commissioning of 4MP@, Vari Focal Dome IR Camera (as per details specification)

12.0	Supply, Installation, Testing & Commissioning of 4MP@, Outdoor type Vari Focal Bullet IR Camera (as per details specification).
13.0	Supply Installation Testing and Commissioning of All in one solution with 64 Channel NVR/VMS Solution with full loaded licenses, which support H.265+ / H.265 / H.264, Audio I/O: 1 Audio IN & 1 Audio Out, Record rate: 320Mbps, Record Mode: Manual, Schedule (Regular, Continuous), Motion Detection, Video Loss, Camera Tamper, Alarm in, Trigger Events: Recording, Buzzer, Push message, Pop up message, Search Mode: Time /Date, Alarm, Picture grid, Event, Max. User Access: 10 Users, Internal HDD Support: 8 SATA Ports, up to 12TB for each HDD, eSATA support, Disk array: RAID 5, RAID 6, RAID 10, Interface: 2 RJ-45 port (10/100/1000Mbps), USB: 3 ports (USB 2.0 x2, USB3.0 x1), Rs485 & Rs232 support, Operating Conditions: -10 °C ~ 50 °C, Certification: EN / CE / FCC / RoHS / BIS etc complete as required and directions of Engineer-in- Charge.
14.0	Supply , Installation , Testing and commissioning of Surveillance Garde 12TB SATA Hard Disk for above VMRs, including fixing accessories and cable termination with required, complete in all respect as per instruction of engineer in-charge. Recording shall be calculated at 2MP, 25fps for 30 days.
15.0	Supply, Installation, Testing and Commissioning of 55" Display Panel having contrast ratio 1200:1, Aspect Ratio: 16:9, Native Resolution : 3,840 X 2, 160 (4K), Brightness : 400 nits, Viewing Angle (H X V): 178 X 178, Surface T treatment : Hard coating (3H) Anti-glare T treatment of the Front Polarizer (Haze 1 % Typ.), Speakers : 10 w x2, Orientation: Landscape & Portrait, Input/Output: HDMI (3), Data Point : RJ45, USB, WIFI, BLUETOOTH, Operation Temperature 0°c to 40°c , Operation Humidity: 10% to 80%, Power Supply: 100-240V~, 50/60Hz, Remote on/off. Source Change, Volume, Generate Reports and Email notifications. Accessories Remote Control, Power Cord, User Guide etc , BIS /ROHS/CE/FCC complete as required.
16.0	Supply, Installation, Testing and Commissioning of 15 Mtr. HDMI Cable.
17.0	Supply, Installation, Testing & Commissioning of Core Switch with 24 x 1G SFP ports with 4 X10G SFP+ ports and 4 x 10/25G SFP28 with switching capacity of 728 Gbps, forwarding performance of 540 Mpps, dual hot swappable internal power supply, Should have Stacking with stacking bandwidth of minimum 200 Gbps. Should support min 4GB internal DRAM, 16GB internal Flash memory, 64K MAC address, 144K IPv4 Routes and 72K IPv6 Routes, MTBF: 195K Hours, Should have static routing OSPF,VXLAN,VRF, PIM and VRRP from Day 1. Should support BGPv4 and IS-IS from Day 1. The Switch should be EAL2/NDcPP , FIPS 140-2 certified and should be managed with both On-premise and Cloud based controller without changing it's Software image.
18.0	Supply, Installation, Testing & Commissioning of 24 Port POE Access Switches with switching capacity of 92 Gbps, forwarding performance 68 Mpps, having 24 x 10/100/1000BASE-T PoE (RJ45) with minimum PoE budget of 180W with 2 x Combo Gigabit RJ-45/ SFP ports and 2 x 10G SFP+ uplink ports. Should support min 1GB internal DRAM, 1GB internal Flash memory, 16K MAC address, 4K VLAN, Latency: < 4 µs. Should have Static Routing , IGMPv3, ISSU, PVST+, LACP, Loopback detection, Built-in CPU protection against malicious attacks. It should be RoHS, WEEE certified and EN 55024: 2010,EN 55022,EN 50581,EN 61000-3-2. The Switch should be managed with both On-premise and Cloud based controller without changing it's Software image.
19.0	Supply, Installation, Testing & Commissioning of 1G Single Mode SFP fiber Modules.
F.	SUB HEAD - VI : FIRE ALARM & EVACUATION SYSTEM

<p>1.0</p>	<p>Supply, Installation, Testing & Commissioning of Addressable 5 loop Microprocessor based intelligent and modular Fire Alarm Panel, 100% electronically addressable system where field device addressing is done by panel and not user, panel should have inbuilt cyber security features to protect from hackers, touch screen should automatically changes the screen colour in normal condition BLUE, fire conditions RED & trouble conditions YELLOW, panel should have HMI touch sensitivity with 7 inch large LCD colour display, optional with zone LED indications or without zone LED indications, system with peer to peer networking of 250 network nodes, panel to panel network should have fault tolerance, panel should be capable to carry full load with 200 devices with any combination of devices, each loop should be drawn upto 600mA current, built in charger that can support backup upto 24 hours idle condition and 30 minutes during alarm condition, capacity to have upto 256 logic zones created, separate sounder circuit card with minimum 2 Output port, panel should be capable of storing up to 11,000 system events including fire, fault, disablements, tests, resets and pre-alarm events, capacity to communicate loop mount repeater panels, optional NAC power supply units that are loop mountable and 100% supervised from main panel. Certification: EN54, LPCB APPROVED</p>
<p>2.0</p>	<p>Supply, Installation, Testing & Commissioning of Intelligent addressable loop mounted Repeater panel with function keys like Reset, Alarm Acknowledge, Alarm Silence, Trouble Acknowledge on panel, 2 x 40 Backlit LCD display, 6 Supervisory LED's, Loop and network connected with battery back-up of 24 hours stand-by & 30 minutes alarming. Certification: EN54 approved.</p>
<p>3.0</p>	<p>Supply, Installation, Testing & Commissioning of Addressable 2 wire Multi-Criteria Detector (Photoelectric Smoke + Heat detection) with built-in short circuit isolator, 100% soft addressing, single LED that covers 360Deg lightpipe technology with intensity that can handle upto 5000 Lux, Drift compensation, detector sensitivity of 2.55+/- 0.33%/ft, Chamber monitoring by panel, option to connect remote indicator. Detector should be provided with Base. Certification: EN54 Approved.</p>
<p>a</p>	<p>Above Detector</p>
<p>b</p>	<p>Below Detector</p>
<p>4.0</p>	<p>Supply, Installation, Testing & Commissioning of Addressable 2 wire Multimode Thermal heat detector with built-in short circuit isolator, 3 operating temperature of detector selectable from panel, 100% soft addressing, single LED that covers 360Deg lightpipe technology with intensity, Discreet design for incorporation into any décor, Common mounting base, Drift compensation, Removable detector chamber, Chamber monitoring by panel, option to connect remote indicator.</p>
<p>5.0</p>	<p>Supply, Installation, Testing & Commissioning of remote indicator discreet design for incorporation in to any décor.</p>
<p>6.0</p>	<p>Supply, Installation, Testing & Commissioning of Addressable 2 wire break glass manual call point with built in short circuit isolator, 100% soft addressed from panel, Wall mounting, resettable key option with back box. Certification: EN54 Approved.</p>
<p>7.0</p>	<p>Supply, Installation, Testing & Commissioning of Addressable loop powered Wall mount sounder with strobe, 100% soft addressed from panel, with 3 tones, Low volume: 87dB at < 8.6mA & High volume: 100dB at < 11mA, shall be with inbuilt isolator. Certification: EN54 Approved.</p>

8.0	Supply, Installation, Testing & Commissioning of EN approved Addressable 2 Wire monitor module, 100% soft addressed from panel, integral short circuit isolators, capable of monitoring NO contacts, Option to choose operation mode as supervision of 20Sec or activation immediate to connect NO/NC contacts such as pressure switch, flow switches, fire pump contacts etc. Certification: EN54 Approved.
9.0	Supply, Installation, Testing & Commissioning of Addressable 2 Wire Control module, 100% soft addressed, integral short circuit isolators, SPDT relay contact to drive sounders load upto 1Amps at 30VDC temperature, Non latching changeover relay contacts, used as output module for shutting down AHU's, and magnetic fire door holders. Elevator recall, fire damper, pressurization fan, speakers, strobes etc.The devicie shall be with inbuilt isolator. Certification: EN54 approved.
10.0	Supply, Installation, Testing & Commissioning of 9 Zone Fire Fighter Telephone System, surface or semi-flush mounted, four navigation keys, 6 status LED's, 4*20 character LCD display, fully duplex, monitor Type A and Type B outstations & emergency assist alarms, panel with built in battery & battery charger, two 30V DC 1A rated volt free relay. Certification: EN54 Approved.
11.0	Supply, Installation, Testing & Commissioning of Roaming handset Red in Color.
12.0	Supply, Installation, Testing & Commissioning of Conventional Jack plate, Full duplex operation, surface or flush mounted, Constructed of Brushed stainless steel.
13.0	Supply, installation, testing and commissioning of GUI based software with capacity to map the complete detector & devices of the fire alarm system. The GUI shall display the propoer layout of the complete solution on the display with real time status.
14.0	Supplying and Laying of 2x1.5 sqmm fire alarm armoured cable, 600/1000V rated with annealed copper conductor having XLPE insulation, steel wire armouring & FRLS outer sheath complete as required.
15.0	Supply, installation, testing and commissioning of 6W Multi-Tap (1.5W; 3W; 6W), Ceiling Mount Speakers.
16.0	Supply, installation, testing and commissioning of 6W Multi-Tap (1.5W; 3W; 6W), Wall Mount Speakers.
17.0	Supply, Installation, Testing & Commissioning of 500W, Class -D Amplifier, 70/100V with rated power 500W.
18.0	Supply, Installation, Testing & Commissioning of 6 Zone PA Controller. It should have functions like the audio playing, zone control, volume control etc.
19.0	Supply, Installation, Testing & Commissioning of Voice command keypad 6 zone, with microphone assembly complete as required.
20.0	Supplying and Laying of 2 C X 1.5 Sq mm multi stranded twisted shielded FRLS Copper cable.

H.	SUB HEAD - VIII : MATV SYSTEM
1	Supply, installation, testing and commissioning of TV Antenna point.
2	Supply and laying of RG-11 Wire.
3	Supply and laying of RG-6 Wire.
4	Supply and laying of Cat-6A
5	Supply, installation, testing and commissioning of 25 mm conduit.
I.	SUB HEAD - IX : UPS SYSTEM
	For Small Medical & Office Equipment
1.0	Supply of True Modular UPS System consisting of 400 KVA /400 KW UPS Frame with 6x60 KW Hot Swappable Modules at unity power factor output to provide (n+1) redundancy to 300kVA/kW load. Bidder to ensure module rating as mentioned above. UPS should have overall efficiency > 97% from 25% to 75% Load range. A True Online Double Conversion UPS using PWM IGBT technology. 3 Phase input 400/415V +/-10% or better at full load and input frequency 50 Hertz plus minus 5%, UPS shall have continuous rating (KVA = KW) available till 40 deg C, no derating due to temperature should be present. Inbuilt Phase Sequence Protection and correction to be provided.100% rated Input, Output, Bypass & Maintenance Bypass Switch, SNMP card provided with UPS shall be having Cybersecurity enhancements for IEC/ UL 2900-2-2 cyber security certification, including stronger encryption, configurable password policy. The card shall work on GIGABIT Speed and should support all major protocols. (Mandatory certificate to be provided by the bidder/ OEM). UPS OEM should supply a type tested "UPS". Detailed type test from Third party lab for IEC 62040-3 standard for same or higher rating (offered Model should match with report) shall be provided along with the bid.
	Input Isolation Transformer - Each UPS Shall have 440 KVA_dry type, isolation transformer (Delta - Star, 415V, Class H insulation) with necessary fan for cooling and Input MCCB, A separate isolation transformer should be provided with each UPS Rack
	Supplying, unloading, installing, testing and commissioning of necessary VRLA batteries of suitable size having 15 minutes back up time on 300kVA Load at 0.8 PF. Vendor to submit battery sizing calculations. UPS with top covered rack and required DC Cable from UPS to Battery Breaker (MCCB) to Battery Bank (consider max. 15 meter distance between UPS & Battery bank). Battery Shall be FR Type
(i)	UPS as described above which includes 1 No 400 KVA/KW Modular Frame filled with 6x60 KW Hot-Swappable Power Modules and providing (n+1) redundancy to 300kVA load along with Transformer, battery, battery accessories - (for Small Medical & Office Equipment)
	For OT

<p>2.0</p>	<p>Supply of True Modular UPS System consisting of 200 KVA + 200KVA Frame in N+N Configuration Each 200KVA with 6 x 25 KW Hot Swappable Modules at unity power factor output and expansion margin till 200KVA in future. Bidder to ensure module rating as mentioned above. UPS should have overall efficiency > 95.5% from 25% to 75% Load range. A True Online Double Conversion UPS using PWM IGBT technology. 3 Phase input 400/415V +/-10% or better at full load and input frequency 50 Hertz plus minus 5%, UPS shall have continuous rating (KVA = KW) available till 40 deg C, no derating due to temperature should be present. Inbuilt Phase Sequence Protection and correction to be provided. 100% rated Input, Output, Bypass & Maintenance Bypass Switch, SNMP card provided with UPS shall be having Cybersecurity enhancements for IEC/ UL 2900-2-2 cyber security certification, including stronger encryption, configurable password policy. The card shall work on GIGABIT Speed and should support all major protocols. (Mandatory certificate to be provided by the bidder/ OEM). UPS OEM should supply a type tested "UPS". Detailed type test from Third party lab for IEC 62040-3 standard for same or higher rating (offered Model should match with report) shall be provided along with the bid.</p>
	<p>Input Isolation Transformer - Each 200KVA shall have 220KVA dry type, isolation transformer (Delta - Star, 415V, Class H insulation) with necessary fan for cooling and Input MCCB , A separate isolation transformer should be provided with each UPS Rack</p>
	<p>Supplying, unloading, installing, testing and commissioning of necessary VRLA batteries of suitable size having 30 minutes back up time on 200kVA Load at 0.8 PF. Vendor to submit battery sizing calculations. UPS with top covered rack and required DC Cable from UPS to Battery Breaker (MCCB) to Battery Bank (consider max. 15 meter distance between UPS & Battery bank). Battery Shall be FR Type Battery Make: Exide / Quanta / panasonic / Ener Rocket</p>
	<p>UPS as described above which includes 2 Nos. 200 KVA/KW Modular Frame, each filled upto 6x25 KW Modules and working in parallel redundant configuration to provide (n+n) redundancy to 150kVA load along with Transformer, battery, battery accessories - (for OT)</p>
	<p>For Hospital Elevators</p>
<p>3.0</p>	<p>Supply of 3x120kVA Monolithic UPS in parallel redundant (n+1) configuration at 0.99 input power factor with SNMP card, compatible for BMS connectivity on backnet/ MODBUS, as per specification given in the document with following broad features.</p>
	<p>THD(i) shall be less than 5% @ 100% Linear Loading.</p>
	<p>Input power factor shall be more than 0.95. from 25% to 100% load.</p>
	<p>UPS shall carry design output at 40 deg.</p>
	<p>Shall have soft start and hold off for incoming supply.</p>
	<p>Inverter capability to supply 126% to 150% load for 1 minute</p>
	<p>Three Phase Input and Three Phase Output. (Input - 340V - 470V, Three Phase, 4 wire./ Output - 400-415 Volt, Three Phase, 4 Wire.)</p>
	<p>UPS shall have inbuilt Heavy duty REGEN kit for handling regenerative load of lift application.</p>
	<p>UPS shall be compatible for minimum 6 nos unit in parallel operation. (Synchronize). Parallel operation kit shall be supplied with UPS.</p>
	<p>Supplying, unloading, installing, testing and commissioning of necessary VRLA batteries of suitable size having 30 minutes back up time on 120kVA Load at 0.8 PF with each 120kVA UPS. Vendor to submit battery sizing calculations. UPS with top covered rack and required DC Cable from UPS to Battery Breaker (MCCB) to Battery Bank (consider max. 10-meter distance between UPS & Battery bank). battery : FR Type Battery Make: Exide / Quanta / panasonic / Ener Rocket</p>
	<p>UPS as described above which includes 3 Nos. 120 KVA monolithic UPS, working in parallel redundant (n+1) configuration</p>

S. No.	Item Of Work
5.0	LIFT PANEL (HOSPITAL BLOCK) –Tower-1, typical to tower-2&3
	Incomer :
	1 No. 160A 4P MCCB (35KA)
-	One (1) No. 160A, 4P, ATS
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 160A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	200A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders (MCCB) shall be of 35kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
-	5 Nos. 63A 4P RCBO.
	3 Nos. 40A 4P, MCB
6.0	HOSPITAL BLOCK PANEL-1
	Incomer :
	One (1) Nos. 3200 A, 4P EDO, ACB. with 3-phase energy meter
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 3200A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	3600A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders (MCCB) shall be of 50kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.

	1 No. 800A 4P MCCB for AHF panel
	Four (4) Nos. 1000 A, 4P EDO, ACB.
-	1 No. 630A 4P MCCB.
-	2 Nos. 400A 4P MCCB.
-	1 No. 315A 4P MCCB.
-	2 Nos. 250A 4P MCCB.
-	1 No. 160A 4P MCCB.
7.0	HOSPITAL BLOCK PANEL-2
	Incomer :
	One (1) Nos. 3200 A, 4P EDO, ACB. with 3-phase energy meter
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 3200A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	3600A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 50kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	1 No. 600A 4P MCCB for AHF panel
	Three (3) Nos. 1000 A, 4P EDO, ACB.
-	2 Nos. 630A 4P MCCB.
-	2 Nos. 400A 4P MCCB.
-	1 No. 315A 4P MCCB.
-	2 Nos. 250A 4P MCCB.
-	1 No. 160A 4P MCCB.
10.0	UPS-INPUT PANEL (OPD, EQUIP, OFFICE)
	Incomer :
	2 Nos. 630A 4P MCCB (50KA) with 3-phase energy meter
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 600A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Bus Coupler
	One (1) No. 630A, 4-pole, MCCB (microprocessor based with all releases) (50kA) with ON/OFF indication.
	Busbar :

	800A TPN AI. Busbar of short circuit withstand capacity 50kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	2 Nos. 400A 4P MCCB. (50kA)
11.0	UPS-OUTPUT PANEL (OPD,EQUIP,OFFICE)
	Incomer :
	2 Nos. 400A 4P MCCB (35KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 400A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Bus Coupler
	One(1) No. 400A, 4-pole, MCCB , 35kA with ON/OFF indication.
	Busbar :
	500A TPN AI. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	2 Nos. 315A 4P MCCB.
-	2 Nos. 200A 4P MCCB.
12.0	UPS-INPUT PANEL (OT)
	Incomer :
	2 Nos. 315A 4P MCCB (50KA) with 3-phase energy meter
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 300A/5A, CL 1.0, 15 VA.
	3Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Bus Coupler
	One(1) No. 315A, 4-pole, MCCB, 50kA with ON/OFF indication.
	Busbar :
	400A TPN AI. Busbar of short circuit withstand capacity 50kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	2 Nos. 250A 4P MCCB.
13.0	UPS-OUTPUT PANEL (OT)

	Incomer :
	2 Nos. 250A 4P MCCB (35KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 250A/5A, CL 1.0, 15 VA.
	3Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Bus Coupler
	One(1) No. 250A, 4-pole, MCCB, 35kA with ON/OFF indication.
	Busbar :
	300A TPN Al. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	2 Nos. 160A 4P MCCB. (35kA)
-	2 Nos. 63A 4P MCCB. (35kA)
-	2 Nos. 40A 4P MCCB. (35kA)
14.0	UPS-LIFT INPUT PANEL (HOSPITAL BLOCK)
	Incomer :
	1 Nos. 400A 4P MCCB (35 KA) with 3-phase energy meter
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 400A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	400A TPN Al. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF/ Trip indication lamps with back up SP MCB.
-	2 Nos. 400A 4P MCCB.
15.0	UPS-LIFT OUTPUT PANEL (HOSPITAL BLOCK)
	Incomer :
	1 Nos. 400A 4P MCCB (35KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 400A/5A, CL 1.0, 15 VA.

	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	400A TPN Al. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF/ Trip indication lamps with back up SP MCB.
-	2 Nos. 400A 4P MCCB.
16.0	MDB UPS (LHS)
	Location : (Typical) GF, 1F, 2F,3F,4F,5F,6F
	Incomer :
-	One (1) No. 160A, 4P, ATS
	One (1) No. 160A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 160A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	200A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	7 Nos. 63A, 4P MCB
	3 Nos. 40A, 4P MCB
17.0	MDB UPS (RHS)
	Location : (Typical) GF
	Incomer :
-	One (1) No. 100A, 4P, ATS
	One (1) No. 100A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 160A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).

-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	200A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	8 Nos. 63A, 4P MCB
	3 Nos. 40A, 4P MCB
18.0	MDB UPS (RHS)
	Location : (Typical) 1F, 2F,3F,4F,5F,6F
	Incomer :
-	One (1) No. 100A, 4P, ATS
	One (1) No. 160A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 160A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	200A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	3 Nos. 63A, 4P MCB
	3 Nos. 40A, 4P MCB
19.0	MDB L+P (LHS)
	Location : (Typical) GF, 1F, 2F,3F,4F,5F,6F
	Incomer :
-	One (1) No. 250A, 4P, ATS
	One (1) No. 250A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 250A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).

-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	300A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	12 Nos. 63A, 4P MCB
	5 Nos. 40A, 4P MCB
20.0	MDB L+P (RHS)
	Location : (Typical) GF
	Incomer :
-	One (1) No. 200A, 4P, ATS
	One (1) No. 200A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 200A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	300A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	17 Nos. 63A, 4P MCB
	5 Nos. 40A, 4P MCB
21.0	MDB L+P (RHS)
	Location : (Typical) 1F
	Incomer :
-	One (1) No. 200A, 4P, ATS
	One (1) No. 200A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 200A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).

-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	300A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	13 Nos. 63A, 4P MCB
	5 Nos. 40A, 4P MCB
22.0	MDB L+P (RHS)
	Location : (Typical) 2F
	Incomer :
-	One (1) No. 100A, 4P, ATS
	One (1) No. 100A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	12 Nos. 63A, 4P MCB
	3 Nos. 40A, 4P MCB
23.0	MDB L+P (RHS)
	Location : (Typical) 3F
	Incomer :
-	One (1) No. 100A, 4P, ATS
	One (1) No. 100A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).

-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	8 Nos. 63A, 4P MCB
	3 Nos. 40A, 4P MCB
24.0	MDB L+P (RHS)
	Location : (Typical) 3F
	Incomer :
-	One (1) No. 100A, 4P, ATS
	One (1) No. 100A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	4 Nos. 63A, 4P MCB
	2 Nos. 40A, 4P MCB
25.0	MDB L+P (RHS)
	Location : (Typical) 4F
	Incomer :
-	One (1) No. 100A, 4P, ATS
	One (1) No. 100A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).

-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	4 Nos. 63A, 4P MCB
	2 Nos. 40A, 4P MCB
26.0	MDB L+P (RHS)
	Location : (Typical) 5F
	Incomer :
-	One (1) No. 100A, 4P, ATS
	One (1) No. 100A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity.
	8 Nos. 63A, 4P MCB
	2 Nos. 40A, 4P MCB
27.0	MDB L+P (RHS)
	Location : (Typical) 6F
	Incomer :
-	One (1) No. 100A, 4P, ATS
	One (1) No. 100A FP MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).

-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	4 Nos. 63A, 4P MCB
	2 Nos. 40A, 4P MCB
29.0	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-1)-Terrace
	Incomer :
	One (1) No. 200A 4P MCCB (50 KA).
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 150A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	200A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	30 Nos. 63A, 4P MCB
30.0	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-1)
	Location :
	Incomer :
	One (1) No.400A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 400A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	500A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.

	Outgoing :
-	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	7 Nos. 63A,4P MCCB
	2 Nos.250A,4P MCCB
	1 Nos.100A,4P MCCB
31.0	HRW PANEL-HOSPITAL BLOCK (TOWER-1)
	Location :
	Incomer :
	One (1) No.250A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 250A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	300A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA breaking capacity
	22 Nos. 40A,TPN MCB
	2 Nos. 63A,TPN MCB
	1 No. 100A, 4P MCCB
	22 Nos. DOL Starters for 0.75 to 3.7 KW.
32.0	VENTILATION PANEL
	Location : GR. FLOOR to SIXTH FLOOR
	Incomer :
	One (1) No.63A FP, MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 60A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	100A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.

	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	4 Nos. 40A,TP MCB
	2 Nos. DOL Starter for 5.6 KW.
33.0	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-1)
	Location :
	Incomer :
	One (1) No.100A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	12 Nos. 16A,TP MCB
	4 Nos. DOL Starter for 1.1 KW.
	1 No. DOL Starter for 5.6 KW.
	1 No. DOL Starter for 2.2 KW.
34.0	Medical EUIP. Panel (LHS)
	Location :
	Incomer :
	One (1) No.1000A FP,EDO, ACB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 1000A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	1200 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :

-	All outgoing feeders shall be of 35kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	1 Nos. 630A, 4P MCCB
	3 Nos. 400A, 4P MCCB
	4 Nos. 250A, 4P MCCB
35.0	MAIN AHU PANEL-HOSPITAL BLOCK (TOWER-2)
	Incomer :
	One (1) No. 100A 4P MCCB (50 KA).
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	10 Nos. 63A, 4P MCB
36.0	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-2)
	Location :
	Incomer :
	One (1) No.400A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 400A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	500A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	11 Nos. 63A,4P MCCB
	2 Nos.200A,4P MCCB
	1 Nos.100A,4P MCCB

37.0	HRW PANEL-SERVICE FLOOR
	Location :
	Incomer :
	One (1) No.250A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 250A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	300A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA breaking capacity
	4 Nos. 40A,TPN MCB
	2 Nos. DOL Starters for 0.75KW.
38.0	VENTILATION PANEL
	Location : GR. FLOOR to SIXTH FLOOR
	Incomer :
	One (1) No.63A FP, MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 60A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	100A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity
	4 Nos. 40A,TP MCB
	2 Nos. DOL Starter for 5.6 KW.
39.0	VENT. PANEL-HOSPITAL BLOCK (TOWER-2)
	Location : Terrace floor
	Incomer :

	One (1) No.200A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 200A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	300A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	11 Nos. 63A,4P MCCB
	2 Nos.200A,4P MCCB
	1 Nos.100A,4P MCCB
40.0	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-3)
	Location :
	Incomer :
	One (1) No.200A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 200A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	250A TPN Al. Busbar of short circuit withstand capacity 50kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color-coded.
	Outgoing :
-	All outgoing feeders shall be of 50kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	2 Nos.160A,4P MCCB
	2 Nos.100A,4P MCCB
42.0	AHU PANEL-1 (Tower-3)
	Location : (SERVICE FLOOR)-GF,1F,2F
	Incomer :
	One (1) No. 200A FP,MCCB

	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 150A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	200A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	34 Nos. 63A, 4P MCB
43.0	AHU PANEL-2 (Tower-3)
	Location : (SERVICE FLOOR)-GF,1F,2F
	Incomer :
	One (1) No.160A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	15 Nos. 63A, 4P MCB
44.0	MAIN VENTILATION PANEL-HOSPITAL BLOCK (TOWER-3)
	Location :
	Incomer :
	One (1) No.250A FP,MCCB
	Incomer shall be provided with the following:

-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 250A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	300A TPN Al. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 35kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	10 Nos. 100A,TP MCCB
	2 Nos. 160A,TP MCCB
45.0	VENTILATION PANEL (TOWER-3 FLOOR PANEL)
	Location : GR. FLOOR to SIXTH FLOOR
	Incomer :
	One (1) No.63A FP, MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 60A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	100A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity
	4 Nos. 40A,TP MCB
	2 Nos. DOL Starter for 5.6 KW.
46.0	FAN SECTION FOR EXH. (NORMAL) (Tower-3) TERRACE
	Location :
	Incomer :
	One (1) No.100A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).

-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	150A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	8 Nos. 40A,TP MCCB
	5 Nos. DOL Starter for 5.6 KW.
47.0	VENT.PANEL-HOSPITAL BLOCK (TOWER-3) Terrace floor (L.H.S)
	Location :
	Incomer :
	One (1) No.160A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 150A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).
-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	200A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 16kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	15 Nos. 40A,TP MCB
	One (1) No.100A FP,MCCB
	13 Nos. DOL Starter for 1.1 to 7.5 KW.
48.0	PRESSURIZATION PANEL-HOSPITAL BLOCK (TOWER-3)
	Location :
	Incomer :
	One (1) No.100A FP,MCCB
	Incomer shall be provided with the following:
-	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A /5A, CL 1.0, 15 VA (ELF-3259 of Conzerv or equivalent from approved make list).

-	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
-	100A TPN Al. Busbar of short circuit withstand capacity 16kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
-	All outgoing feeders shall be of 10kA (Min.) breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	25 Nos. 40A,TP MCCB
	4 Nos. DOL Starter for 1.1 KW.
	1 Nos. DOL Starter for 2.2 KW.
	6 Nos. DOL Starter for 5.6 KW.

R&D / ACADMIC BLOCK

S.No.	Description of Item
I.	SUB HEAD - I : POINT WIRING & ACCESSORIES
	WIRING IN MS CONDUIT
1.0	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable etc. as required.
a.	Group C
2.0	Wiring for group controlled (looped) light point/fan point/exhaust fan point/ call bell point (without independent switch etc.) with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, and earthing the point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable etc. as required.
a.	Group C
3.0	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit alongwith 1 No. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.
4.0	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit alongwith 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.
5.0	Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed steel conduit as required.
	FOR LIGHTING CIRCUIT/ SUB MAIN WIRING
a.	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire
b.	2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire
c.	2 X 6 sq. mm + 1 X 6 sq. mm earth wire
d.	4 X 6 sq. mm + 2 X 6 sq. mm earth wire
e.	4 X 10 sq. mm + 2 X 6 sq. mm earth wire
f.	4 X 16 sq. mm + 2 X 6 sq. mm earth wire
6.0	Supplying and fixing of following sizes of PVC conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.
a.	25 mm dia

b.	32 mm dia
7.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections etc. as required. (1x6A socket)
8.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 5/6 & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. as required. (1x16A socket)
9.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 2 nos. 3 pin 5/6 A modular socket outlet and 2 nos. 5/6 A modular switch, connections etc. as required. (For light plugs to be used in non residential buildings). (2x6A socket)
	TOTAL OF POINT WIRING & ACCESSORIES
II.	SUB HEAD - II : MV DISTRIBUTION BOARDS
1.0	MCB DISTRIBUTION BOARDS
1.1	Supplying and fixing following way, single pole and neutral , sheet steel, MCB distribution board, 240 volts, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/RCCB/Isolator)
a.	12 way, Double door
1.2	Supplying and fixing following way, horizontal type three pole and neutral , sheet steel, MCB distribution board, 415 V, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/RCCB/Isolator)
a.	4 way (4 + 12), Double door
b.	6 way (4 + 18), Double door
c.	8 way (4 + 24), Double door
d.	12 way (4 + 36), Double door
1.3	Supplying and fixing 5 A to 32 A rating, 240/415 V, 10 kA, "C" curve, miniature circuit breaker suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a.	Single pole

1.4	Supplying and fixing following rating, double pole, (single phase and neutral) , 240 V, residual current circuit breaker (RCCB) , having a sensitivity current 30 mA in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a.	40 A
b.	63 A
1.5	Supplying and fixing single pole blanking plate in the existing MCB DB complete etc. as required.
1.6	Supplying and fixing following rating, 'C' series, four pole, 415 volts, MCB in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a.	40 amps
b.	63 amps
1.7	VTPN DB
	Supply, Installation, Testing and Commising of VTPN DBs as per GFC Drawing.
	TOTAL OF MV DISTRIBUTION BOARDS
III.	SUB HEAD - III : LIGHT FIXTURE (As per Lighting Schedule) & FAN
16.0	Supply, Installation, Testing and Commissioning of 1200 mm sweep , BEE 5 star rated, ceiling fan with Brush Less Direct Current (BLDC) Motor, class of insulation: B, 3 nos. blades, 30 cm long down rod, 2 nos. canopies, shackle kit, safety rope, copper winding, Power Factor not less than 0.9, Service Value (CM/M/W) minimum 6.00, Air delivery minimum 210 Cum/Min, 350 RPM (tolerance as per IS : 374-2019), THD less than 10%, remote or electronic regulator unit for speed control and all remaining accessories including safety pin, nut bolts, washers, temperature rise=75 degree C (max.), insulation resistance more than 2 mega ohm, suitable for 230 V, 50 Hz, single phase AC Supply, earthing etc. complete as required.
17.0	Supplying and fixing extra conduit down rod of 20 cm length G.I. pipe 15 mm dia, heavy gauge including painting etc. as required. (Note : More than 5 cm length shall be rounded to the nearest 10 cm and 5 cm or less shall be ignored)
IV.	SUB HEAD - IV : MV PANELS

	Design, manufacture, supply, installation, testing and commissioning of following Utility panels suitable for 415 V, 3 phase, 4 wire, 50 Hz power distribution system. The panel shall be Indoor, free standing, floor mounting, sheet metal clad, cubicle, dead front, dust and vermin proof type compartmentalised design fabricated out of 2mm thick CRCA sheet steel for Load bearing members and 1.6 mm thick for non-load bearing members, complete with colour coded, heat shrinkable PVC insulated, aluminium bus bars and separate earth bus bar of adequate cross section through out the length of the panel. The incoming and outgoing feeders shall be accommodated in a fully segregated, modular multitier arrangement with adequate size and distinct cable alley, bus bar alley/chamber (form-3b Construction). The panel shall be complete with name plate, earthing, numbering, danger plate etc. as required and as per specifications and drawings. The panel shall withstand the fault level of as indicated elsewhere or shown in Single Line Diagrams.
	Important Notes: Common for all Switchboard:
	-
1	The BOQ shall be read inconjunction with general notes, specification and Single Line Diagram (attached for Ref.). Incase of any discrepancy between specification, BOQ and SLD, the same shall be brought to the notice of Client/Consultant before quoting the rates, otherwise stringent condition shall be deemed to have been considered.
2	Fault current wherever mentioned shall be Ics value. (Ics = 100% Icu).
3	All MCCB shall be provided with door interlocked rotary handle with ON/TRIP/OFF position indicator, continious variable thermal magnetic O/C and S/C releases. The MCCB above 250A rating shall be provided with microprocessor based releases.
4	Incoming MCCBs shall be provided with O/C, selective S/C, Instentaneous short circuit protection releases.
5	Outgoing MCCBs shall be provided with O/C, and selective short circuit protection.
6	All feeder doors shall have pad locking arrangement.
7	All TP feeders shall have solid isolable neutral link.
8	All MCCB used in starter feeder shall be suitable for motor duty application.
9	All power contactors including NIC shall be of AC3 duty.
-	-
10	Panel shall be powder coated of approved shade with minimum 60 micron thickness.
11	Size of Voltmeter/ Ammeter for incomer also, 96mm x 96mm flush mounted with shrouded terminal shall be used in the panel.
12	Bus bar chamber shall be kept at top of the all panels.
13	All bus bar shall be insulated with coloured PVC Sleeve i.e.RYB, BK as per colour code.
14	Internal wiring of panel shall be with size 2.5sqmm Flexible Copper Conductor for CT circuit and control wiring with 1.5 sqmm.

15	All indicating light shall be LED type .
16	Each vertical section of floor mounted panel shall have independent base frame (75mm x 40mm) size made out of 3 mm sheet steel (LT Panel & DG Panel).
17	All the makes shall be as per approved make list only.
18	Wherever only voltmeter & ammeter are required, the same may be provided in combined meter suitable for both parameter.
19	Space heater shall be provided in each cable alley.
20	All links/drops for ACB/MCCB shall be designed for full rated current of ACB/MCCB rating at same current density of Main Bus Bar.
21	All switchgear used in starter feeder shall be type-2 co-ordinated. Vendor is required to submit manufacturer's type-2 co-ordination chart for the make used.
22	Arch flase Protection shall be in Cable allay & busbar Chember.
23	Fault rating of RCCB shall be equal to the fault rating of MCBs.
24	Necessary Co-ordination shall be done by the Panel Manufacturer/ Vendor with the vendor of "Gas flooding system" for fire protection, for making suitable provisions in the panels, at the Design stage, Manufacturing stage, stage of testing at works & stage of commissioning at site.
1.0	MAIN ACADEMIC PANEL
	Incomer :
	1 Nos. 800A 4P EDO ACB(50KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 800A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	1000A TPN Al. Busbar of short circuit withstand capacity 50kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 50kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	2 Nos. 400A 4P MCCB
	2 Nos. 200A 4P MCCB

	4 Nos. 160A 4P MCCB
2.0	UPS INCOMER PANEL (ACADEMIC BLOCK)
	Incomer :
	1 No. 200A 4P MCCB (35KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 200A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	250A TP+2N Al. Busbar of short circuit withstand capacity 50kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF/ Trip indication lamps with back up SP MCB.
	2 Nos. 160A 4P MCCB.
3.0	UPS OUTGOING PANEL (ACADEMIC BLOCK)
	Incomer :
	1 Nos. 160A 4P MCCB (35KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 160/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	200A TPN Al. Busbar of short circuit withstand capacity 50kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF/Trip indication lamps with back up SP MCB.
	2 Nos. 125A 4P MCCB.
4.0	LIFT PANEL (ACADEMIC BLOCK)
	Incomer :
	1 Nos. 160A 4P MCCB (35KA)

	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 150A/5A, CL 1.0, 15 VA.
	Busbar :
	200A TP+2N Al. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF/Trip indication lamps with back up SP MCB.
	9 Nos. 40A 4P RCBO.
5.0	FLOOR PANEL MDB (L+P)
	Incomer :
	1 Nos. 250A 4P MCCB (35kA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 250A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	300A TPN Al. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF/ Trip indication lamps with back up SP MCB.
	8 Nos. 40A 4P MCB.
	9 Nos. 63A 4P MCB.
6.0	MDB (UPS) Panel_Ground Floor
	Incomer :
	1 Nos. 125A 4P MCCB
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 125A/5A, CL 1.0, 15VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	150A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.

	Outgoing :
	All outgoing feeders shall be of 25kA breaking capacity and shall be provided with ON/OFF/Trip indication lamps with back up SP MCB.
	7 Nos. 32A DP MCB.
	7 Nos. 63A 4P MCB.
7.0	MAIN AHU PANEL-ACADEMIC BLOCK
	Incomer :
	1 Nos. 160A 4P MCCB (35KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 150A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/Trip with control SP MCB.
	Busbar :
	200A TPN Al. Busbar of short circuit withstand capacity 35kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	11 Nos. 63A 4P MCCB
8.0	AHU PANEL - Floor Panel
	1 No. 63A 4P MCCB (25KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 60/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	100A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 25kA breaking capacity and shall be provided with ON/OFF/ Trip indication lamps with back up SP MCB.
	4 Nos. 40A 4P MCB
9.0	STATER PANEL

	Star Delta Panel with complete of all accessories.
10.0	STATER PANEL
	DOL Stater Panel with complete of all accessories.
11.0	MAIN VENTILATION PANEL-ACADMIC BLOCK
	Incomer :
	1 Nos. 160A 4P MCCB (35KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 150A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	200A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 25kA breaking capacity and shall be provided with ON/OFF/ Trip indication lamps with back up SP MCB.
	8 Nos. 63A 4P MCCB.
	2 Nos. 125A 4P MCCB.
12.0	VENTILATION PANEL
	Location: GF (Typical to 4F)
	Incomer :
	1 Nos. 63A 4P MCCB
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 60A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	100A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 10kA breaking capacity and shall be provided with ON/OFF/Trip indication lamps with back up SP MCB.
	2 Nos. 40A 4P MCB with DOL starter for 0.37 to 2.5kW.
	2 Nos. 40A 4P MCB.

13.0	VENTILATION PANEL
	Location: Terrace
	Incomer :
	1 Nos. 125A 4P MCCB
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 125A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	150A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 25kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	3 Nos. 40A 4P MCB with Star-Delta starter for 7.5kW.
	2 Nos. 40A 4P MCB.
	1 Nos. 100A 4P MCCB
14.0	PRESSURIZATION PANEL
	Location: Terrace
	Incomer :
	1 Nos. 100A 4P MCCB (25KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	150A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 10kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	3 Nos. 16A TPN MCB.
	7 Nos. 16A TPN MCB with DOL starter for 1.1 to 2.5kW.
V.	SUB HEAD - V : CABLES & CABLE TRAYS

1.0	Supply, loading, transportation unloading at site, storages at site, shifting from storage place to site of following sizes of XLPE insulated PVC sheathed, FRLS, Aluminium conductor armoured power cable of 1.1 KV grade conforming to IS amended upto date and as per specifications.
(i)	4 X 16 sq. mm
(ii)	4 X 10 sq. mm
4.0	Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed/ XLPE aluminium conductor cable of 1.1 KV grade as required.
(i)	4 X 16 sq. mm (28mm)
(ii)	4 X 10 sq. mm (25 mm)
5.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron tray (Galvanisation thickness not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
(i)	150 mm width x 50 mm depth x 1.6 mm thickness
(ii)	300 mm width X 50 mm depth X 1.6 mm thickness
(iii)	450 mm width X 50 mm depth X 2.0 mm thickness
(iv)	600 mm width X 50 mm depth X 2.0 mm thickness
(v)	900 mm width X 62.5 mm depth X 2.0 mm thickness
6.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray "bends" (galvanisation not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
(i)	150 mm width x 50 mm depth x 1.6 mm thickness
(ii)	300 mm width X 50 mm depth X 1.6 mm thickness
(iii)	450 mm width X 50 mm depth X 2.0 mm thickness
(iv)	600 mm width X 50 mm depth X 2.0 mm thickness
(v)	900 mm width X 62.5 mm depth X 2.0 mm thickness
7.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray "Tee" (galvanisation not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
(i)	150 mm width x 50 mm depth x 1.6 mm thickness
(ii)	300 mm width X 50 mm depth X 1.6 mm thickness
(iii)	450 mm width X 50 mm depth X 2.0 mm thickness
(iv)	600 mm width X 50 mm depth X 2.0 mm thickness
(v)	900 mm width X 62.5 mm depth X 2.0 mm thickness

8.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray " Cross member " (galvanisation not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
(i)	150 mm width x 50 mm depth x 1.6 mm thickness
(ii)	300 mm width X 50 mm depth X 1.6 mm thickness
(iii)	450 mm width X 50 mm depth X 2.0 mm thickness
(iv)	600 mm width X 50 mm depth X 2.0 mm thickness
(v)	900 mm width X 62.5 mm depth X 2.0 mm thickness
9.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray " Reducer " (galvanisation not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
(i)	150 mm width x 50 mm depth x 1.6 mm thickness
(ii)	300 mm width X 50 mm depth X 1.6 mm thickness
(iii)	450 mm width X 50 mm depth X 2.0 mm thickness
(iv)	600 mm width X 50 mm depth X 2.0 mm thickness
(v)	900 mm width X 62.5 mm depth X 2.0 mm thickness
10.0	Supply, loading, transportation unloading at site, storages at site, shifting from storage place to site of following sizes of XLPE insulated PVC sheathed, Copper conductor armoured power Cable of 1.1 KV grade conforming to IS 7098 amended upto date.
(i)	1C x 120 Sq.mm
11.0	Cable end termination with brass double compression gland and copper lugs for following size of XLPE insulated and PVC sheathed copper conductor cable of 1.1kV grade as required.
(i)	1C x 120 Sq.mm
VI.	SUB HEAD - VI : LV SYSTEM LOW SIDE (TELEPHONE, TV & Wi-Fi SYSTEM)
A.	TELEPHONE SYSTEM:
1.0	Supply and installation of plug - in type socket outlet with G.I outlet box and cover plate complete as required in 3 module plate.
a)	RJ - 45
2.0	Supply, fixing, testing & commissioning of Modular RJ-11 telephone outlets with grid & cover plate in suitable size of 16 SWG GI box.
3.0	Supply and laying of 4 Pair UTP Cable 23 AWG copper with integral cross-member pair separator (bidirectional tape, strips and others will not be accepted) (Cat-6) standards for physical and electrical specifications. (Only for telephone & Wifi outlet)

a)	Cat 6 cable
4.0	Supplying and laying in position as desired by Project Manager of following sizes of heavy duty PVC conduit on surface/recess including, fish wire cutting/filling chases along with conduit accessories etc. complete as required for TV outlet to ONT inside apartment and ONT to LV shaft.
a)	20 mm dia heavy duty PVC conduit
b)	25 mm dia heavy duty PVC conduit
B)	TV SYSTEM
1.0	Supply and installation of 1.2mm thick GI Box with cover plate complete with all accessories as required.
2.0	Supplying and fixing 250x150x75 mm deep, 1.6 mm thick G I Junction box with coverplate complete as per site requirement. (To be installed above ONT for loose wire)
C).	Wi-Fi SYSTEMS
1	Supply, Installation, Testing & Commissioning of the Microservices based WLAN Architecture. The indoor AP should have radios to support 2.4Ghz and 5 Ghz band in a 4X4:4 Mu-MIMO configuration with support for 802.11 a/b/g/n/ac. The AP should have internal Omni Antennas and should support vBLE and RF optimization. It should also support way finding and asset tracking via bluetooth. Should support Artificial Intelligence platform, WIPS/WIDS to detect Rogue APs and the facility to terminate connection to the Rogue APs. Plenum rated and support for UL 60950-1 CAN/CSAC22.2 No. 60950-1, FCC Part 15.247, 15.407, 15.107, and 15.109 RSS247 ICES003.
2	Supply, Installation, Testing & Commissioning of Appliance Server based customised ITAM for asset inventory management with ability to map physical locations and exact rack elevations for audit and support control. Appliance shall be Intel x86 based device with secure intranet server with Linux Based operating system and relational databases for long term storage. Appliance includes license for 500 units under control.
VII.	SUB HEAD - VII : IP CCTV & ACCESS CONTROL SYSTEM
1	Supply, Installation, Testing and commissioning of Cat6 23 AWG Solid Copper Conductor UTP LSZH Cable roll of 305 Mtr, in accordance to IEC 60332-2-33, ANSI/TIA 568 C.2, UL 444, IEC 60754 -1,2 & 3, IEC 60134-2 and ISO/IEC 11801-2nd Edition, 250 Mhz tested and UL & ETL Listed Cable, Grey, RoHS Certified for Connectivity of Hub room to End Point.
2	Supply, Installation, Testing & Commissioning of CAT6 UTP JACK, Universal (tool/toolless), As per ANSI/TIA 568 A/B wiring system, UL & ETL Verified- Blue for Camera at user end.

3	Supply, Installation, Testing & Commissioning of loaded 24-Port 1U loaded Universal Modular Straight Patch Panel, pre loaded with cable support Bar, Individual port transparent shutter and labelling point, Preloaded earthing plug for surge protection. UL & ETL Verified. CRC Metal with Black Powder Coated. RoHS Compliant, in accordance to ANSI/TIA-568-C.2, ISO/IEC 11801:2002/AMMD.2:2010, YD/T 926.3-2009, ISO/IEC 60603-7 standards. Safety parameters as per UL 94V-0, at rack end.
4	Supply, Installation, Testing & Commissioning of Cat6 UTP 24AWG, Stranded Flexible, LSZH Jacket, in accordance to ANSI/TIA 568C.2 Patch Cord, Complying to UL94-V-0 BLUE 1 Mtr for rack side switch to jack panel connectivity.
5	Supply, Installation, Testing & Commissioning of Cat6 UTP 24AWG, Stranded Flexible, LSZH Jacket, in accordance to ANSI/TIA 568C.2 Patch Cord, Complying to UL94-V-0 BLUE 2 Mtr for rack side switch to jack panel connectivity.
6	Supply, Installation, Testing & Commissioning of 1, 2 and 4 Port British Style Spring Shutter Face Plate with elegant 2 Piece design ABS-UL94-V2, 86x86x12.8 (mm). Straight white for I/O fixing at user side.
7	Supply, installation, testing and commissioning of Dome Camera , (as per details specification).
8	Supply, installation, testing and commissioning of Bullet Camera , (as per details specification)
9	Supply, installation, testing and commissioning of 64 channel NVR, ONVIF compliant, recording bandwidth 640 Mbps, output interface 1 HDMI (up to 4K), 1 VGA, Alarm in/out :16ch in/ 4ch out , 1 X RJ45 ethernet , iOS smartphone support, 8 HDD support , each HDD slot support upto 8 TB HDD, RAID support , 1x3.0 USB for backup /upgrade , 2x 2.0 USB for mouse. Edge analytics of proposed cameras must be integrated with NVR . Artificial Intelligence Support having face recognition with compatible deep learning supported cameras, AI-Face registered quantity upto 10,000 ,AI maximum captured quantity 200,000. UL,CE,FCC certified.
10	Supply, Installation, Testing & Commissioning of 8TB Surveillance Hard Disk.
11	Supply, Installation, Testing and Commissioning of Full HD 55" LED Professional Display Panel.
12	Supply, Installation, Testing and Commissioning of Rack Mounted Industrial 24 port L2+ Managed switch having 24*10/100/1000Base-T POE ports, 4*100/1000Base-X uplink SFP ports, 1*RS232 Console port. Forwarding Rate @ 64 byte 38.69Mpps .Operation TEMP/ Humidity -40~+85°C.
13	Supply, Installation, Testing and Commissioning of Core Switch with 1*USB 2.0 port, 24*1/10G SFP+ fiber ports (Data), 1*RS232 Console port(9600,8,N,1), 4*40G/100G QSFP28 fiber ports (Data)1*10/100/1000M RJ45 management port(Data), Forwarding Rate @ 64byte 952Mpps. Operation TEMP/ Humidity -20 to +55°C.

14	Supply, Installation, Testing and Commissioning of Workstation PC: Intel(R) Core(TM) i7-3770 Processor (8M Cache, up to 3.90 GHz); RAM: 8GB (1x8GB) Non-ECC DDR3 1600MHz; Keyboard: 12 function keys; Chassis: Tower/Workstation; DVD: 8X Slimline DVD+/-RW, Data Only; Dual Graphics Card; Network interface card: Integrated Intel(R) 82579LM Gigabit1 Ethernet LAN 10/100/1000; Hard disk: 250GB, 7200 RPM 3.5" SATA 6Gb/s Hard Drive; Operating system: Windows 7 Professional 64 Bit or latest.
I.	FIRE DETECTION SYSTEM
1	FIRE ALARM CONTROL PANEL
	Supplying, installation, testing and commissioning of micro processor based intelligent addressable main fire alarm panel, central processing unit with the following loop modules and capable of supporting not less than 240 devices (including detectors) and minimum 120 detectors per loop and loop length up to 2 km, network communication card, minimum 320 character graphics/ LCD display with touch screen or other keypad and minimum 4000 events history log in the non volatile memory (EPROM), power supply unit (230 ± 5% V, 50 hz), 48 hrs back-up with 24 volt sealed maintenance free batteries with automatic charger. The panel shall have facility to connect printer to printout log and facility to have seamless integration with analog/digital voice evacuation system (which is part of the schedule of work under SH: Evacuation System) and shall be complete with all accessories. The panel shall be compatible for IBMS system with open protocol BACnet/ Modbus over IP complete as per specifications.
a.	4 Loop
2	Supplying, installation, testing & commissioning of central graphical fire alarm management system to centrally monitor and operate the fire alarm system complete as required.
3	Supplying, installation, testing & commissioning of repeater panel with 320 character/ Touch screen LCD display with inbuilt reset, acknowledge and silence switches complete as required.
4	Supplying, installation, testing & commissioning of intelligent multicriteria detector or addressable photothermal detector complete with mounting base complete as required.
a.	Below False Ceiling
b.	Above False Ceiling
5	Supplying, installation, testing & commissioning of response indicator on surface/ recessed MS Box having two LED, metallic cover complete with all connections etc as required.
6	Supplying, installation, testing & commissioning of fault isolator complete with base as required.
7	Supplying, installation, testing & commissioning of intelligent addressable thermal detector with rate of rise cum fixed temperature thermistor complete with base as required.
8	Supplying, installation, testing & commissioning of addressable fire control module complete as required.

9	Supplying, installation, testing & commissioning of addressable beam detector with short circuit isolator (inbuilt or separate) complete with emitter and receiver including connections with remote test features etc. complete as required.
10	Supplying, installation, testing & commissioning of addressable manual call point complete as required.
11	Supplying, installation, testing & commissioning of addressable horn cum strobe complete as required.
12	Supplying, installation, testing & commissioning of fire fighter telephone handset complete as required.
13	Supplying, installation, testing & commissioning of intelligent interface unit BACnet/Modbus protocol i.e. supplying communication links between building management system and fire alarm control panel complete as required.
14	Supplying, installation, testing & commissioning of fire fighter phone jack complete as required.
15	MONITOR MODULES
	Supply, Installation, Testing & Commissioning of Addressable Monitor Module for Sprinklers, Panic Bars & other Third Party Inputs. The monitor module shall monitor potential free contacts. The device shall have an LED which shall blink in normal state & get steady on activation to monitor the health status of the device. Addressing shall be with user friendly rotary decimal switches. Module shall be supplied with mounting plate from OEM for ease of installation & maintenance UL & FM Approved.
16	Supply, installing, testing and commissioning of Addressable Relay Module for AHU, Access Control, Lifts, Staircase Pressurization, Fire Suppression & other Third Party Outputs. The relay module shall provide contact rated at 24v DC, 2A. The device shall have an LED which shall blink in normal state & get steady on activation to monitor the health status of the device. Addressing shall be with user friendly rotary decimal switches. Module shall be supplied with mounting plate from OEM for ease of installation & maintenance UL & FM Approved.
14	Supplying & laying of 2x1.5 sqmm fire survival armoured cable, 600/1000V rated with annealed copper conductor having glass mica fire barrier tape covered by an extruded layer of Cross Linkable Ethylene Propylene Rubber (EPR) insulation and LSZH inner bedding, steel wire armouring & LSZH outer sheath complete as required.
15	Supply, Installation, testing and Commissioning of Exit Signage Light with 3hrs Battery Backup Twin Side available in Green/Red Colour.
II.	EVACUATION SYSTEM
1	SPEAKERS
	Supplying, installation, testing & commissioning of 1.5/3/6W metal box ceiling/wall speakers complete as required.

2	Supplying, installation, testing & commissioning of digital audio amplifier 75 Watt, 25V rms operating at 240 Volt AC Supply complete as required.
3	Supplying and drawing of cable Fire Retardant PVC insulated copper conductor cable in the existing surface/ recessed steel conduit of following pairs, cores and size including connections and interconnections etc. as required.
a)	speaker cable Two pair, 2-core, 1.5 sqmm
4	PA CONTROLLER Supply, Installation, Testing & Commissioning of 8 zone IP based, digital Voice Alarm controller expandable upto 128 zones. The voice alarm controller should be able to connect directly over Ethernet. It should have functions like the audio playing, zone control, fault monitoring, log recording, volume control and amplifier switchover. The Voice alarm controller should also have the following functions: <ul style="list-style-type: none"> . 255 Priorities . Time schedule broadcasts . Its own PTT microphone . Capable of amplifier redundancy . 8 trigger inputs/outputs.
5	PAGING STATION Supply, Installation, Testing & Commissioning of IP based Networkable touch screen paging station for selection of zones, supervision of system status, setting of scheduled broadcasts with the following functions: <ul style="list-style-type: none"> . Built-in monitoring loudspeaker . Detachable goose-neck microphone . LCD touchscreen display . Audio input.
X.	SUB HEAD - X: LIGHTNING PROTECTION & EARTHING
1.0	LIGHTNING PROTECTION
1.1	Fixing clamp for (1500 mm) air terminal, DEHN Part No. 306029
1.2	Air Terminal 1.5 mtr. side wall, DEHN Part No.104250 Clamp for holding 1.5 mtr. air terminal on wire fence Clamp for connecting air terminal rod to 8mm Conductor, DEHN Part No. 380116
1.3	Universal Clamp, DEHN Part No. 315119
1.4	Al Round Conductor on roof (Ø 8mm), Dehn Part No. 840008 Al Round Conductor Holder for wall with accessories wall plug & screw, Dehn Part No. 274150
1.5	Al Down Conductor (Ø 8mm), Dehn Part No. 840008 Al Down Conductor Holder for wall with accessories wall plug & screw, Dehn Part No. 274150

1.6	Test Clamp, Dehn Part No. 459139
1.7	GI Strip for Down Conductor to earth (25x6 mm)
1.8	GI Strip holder (25x6 mm)
1.9	17.2 mm Copper bonded UL listed rod of 3 mtr length
1.10	Environment friendly, RoHS certified, low resistivity Ground Enhancement material in 22.6 Kg pack to fill the bore area around the rod.
1.11	StSt 316 grade clamp to terminate the load on earth electrode
1.12	Poly Plastic Pit Cover
1.13	GI Strip 25x6mm for Interconnecting Earth Pits
XII.	SUB HEAD - XII : ELEVATORS
1.0	PASSENGER LIFT (G+4)
	Design Manufacture, Supplying delivery at site, Installation, Testing & Commissioning of Machine Room Gearless Elevator (Regenerating Type) in Shaft of dimensions 2150 mm x 3000 mm (W x D) for minimum payload carrying capacity of 16 passenger/ 1088 kg serving different floors as per specifications as under:-
	Location of Lift : R&D and Academic Block (As per Lift Shedule)
2.0	PASSENGER LIFT (G+4)
	Design Manufacture, Supplying delivery at site, Installation, Testing & Commissioning of Machine Room Gearless Elevator (Regenerating Type) in Shaft of dimensions 2150 mm x 2400 mm (W x D) for minimum payload carrying capacity of 13 passenger/ 884 kg serving different floors as per specifications as under:-
	Location of Lift : R&D and Academic Block (As per Lift Shedule)

RESIDENTIAL & HOSTEL BLOCK

Item No.	Description Of Item
I.	SUB HEAD - I : POINT WIRING & ACCESSORIES
	WIRING IN MS CONDUIT
1.0	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable etc. as required.
b.	Group C
2.0	Wiring for group controlled (looped) light point/ fan point/ exhaust fan point/ call bell point (without independent switch etc.) with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed steel conduit, and earthing the point with 1.5 sq.mm. FRLS PVC insulated copper conductor single core cable etc as required.
b.	Group C
3.0	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit alongwith 1 No. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.
4.0	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit alongwith 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.
5.0	Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed steel conduit as required.
	FOR LIGHTING CIRCUIT / SUB MAIN WIRING
a.	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire (For Light Circuit)
b.	2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire (For 6 Amp Points-UPS)
c.	4 X 10 sq. mm + 2 X 6 sq. mm earth wire
d.	4 X 16 sq. mm + 2 X 6 sq. mm earth wire
6.0	Supplying and fixing of following sizes of PVC conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.
a.	20 mm dia
b.	25 mm dia
c.	32 mm dia
d.	40 mm dia
7.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections etc. as required. (1x6A)

8.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing of 6 pin 5/6 & 15/16 amps modular socket outlet and 15/16 amps modular switch , connection etc. as required. (1x16A)
9.0	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 2 Nos 3 pin 5/6 amps modular socket outlet and 2 Nos. 5/6 amps modular switch , connection etc. as required. (For light plugs to be used in non residential buildings). (2X6A)
10.0	Supplying and fixing 20 amps, 240 volts, SPN industrial type, socket outlet, with 2 pole and earth, metal enclosed plug top alongwith 20 amps "C" curve, SP MCB , in sheet steel enclosure, on surface or in recess, with chained metal cover for the socket out let and complete with connections, testing and commissioning etc. as required. (1X20A)
11.0	Supplying and fixing modular blanking plate on the existing modular plate & switch box excluding modular plate as required.
II.	SUB HEAD - II : MV DISTRIBUTION BOARDS
1.0	MCB DISTRIBUTION BOARDS
1.1	Supplying and fixing following way, single pole and neutral , sheet steel, MCB distribution board, 240 volts, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/RCCB/Isolator)
a.	10 way, Double door
b.	12 way, Double door
1.2	Supplying and fixing following way, horizontal type three pole and neutral, sheet steel, MCB distribution board , 415 volts, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/ RCCB/ Isolator)
a.	8 way (4 + 24), Double door
b.	12 way (4 + 36), Double door
1.3	Supplying and fixing 5 A to 32 A rating, 240/415 V, 10 kA, "C" curve, miniature circuit breaker (MCB) suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a.	Single pole
1.4	Supplying and fixing single pole blanking plate in the existing MCB DB complete etc. as required.
1.5	Supplying and fixing following rating, double pole, (single phase and neutral), 240 V, residual current circuit breaker (RCCB), having a sensitivity current 30mA in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a.	40 A
b.	63 A
1.6	Supplying and fixing DP sheet steel enclosure on surface / recess along with 25/32 A , 240 V "C" curve DP MCB and complete with connections, testing and commissioning etc. as required.

1.7	Supplying and fixing TP sheet steel enclosure on surface/ recess along with 16/25/32 A, 415 V "C" curve TP MCB and complete with connections, testing and commissioning etc. as required.
1.8	Supplying and fixing following rating, 'C' series, four pole , 415 volts, MCB in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a.	40 amps
b.	63 amps
III.	SUB HEAD - III : LIGHT FIXTURES & FAN (Shall be as per Attached Lighting Schedule)
12.0	Supply, Installation, Testing and Commissioning of 1200 mm sweep , BEE 5 star rated, ceiling fan with Brush Less Direct Current (BLDC) Motor, class of insulation: B, 3 nos. blades, 30 cm long down rod, 2 nos. canopies, shackle kit, safety rope, copper winding, Power Factor not less than 0.9, Service Value (CM/M/W) minimum 6.00, Air delivery minimum 210 Cum/Min, 350 RPM (tolerance as per IS : 374-2019), THD less than 10%, remote or electronic regulator unit for speed control and all remaining accessories including safety pin, nut bolts, washers, temperature rise=75 degree C (max.), insulation resistance more than 2 mega ohm, suitable for 230 V, 50 Hz, single phase AC Supply, earthing etc. complete as required.
13.0	Supplying and fixing extra conduit down rod of 20 cm length G.I. pipe 15 mm dia, heavy gauge including painting etc. as required. (Note : More than 5 cm length shall be rounded to the nearest 10 cm and 5 cm or less shall be ignored)
14.0	Installation, testing & commissioning of 240V, 1 phase Exhaust fans with 1.5 Sqmm insulated copper conductor wires for connections complete with all accessories as required.
a)	Upto 450 mm sweep
15.0	Installation, testing & commissioning of 240V, 1 phase wall fans with 1.5 Sqmm insulated copper conductor wires for connections complete with all accessories as required.
a)	300 mm sweep
16.0	Supply, installation, testing and commissioning of Lighting Automation for Guest House.
17.0	Supply, installation, testing and commissioning of Key Tag for Guest Room.
IV.	SUB HEAD - IV : MV PANELS
	Design, manufacture, supply, installation, testing and commissioning of following Utility panels suitable for 415 V, 3 phase, 4 wire, 50 Hz power distribution system. The panel shall be Indoor, free standing, floor mounting, sheet metal clad, cubicle, dead front, dust and vermin proof type compartmentalised design fabricated out of 2mm thick CRCA sheet steel for Load bearing members and 1.6 mm thick for non-load bearing members, complete with colour coded, heat shrinkable PVC insulated, aluminium bus bars and separate earth bus bar of adequate cross section through out the length of the panel. The incoming and outgoing feeders shall be accommodated in a fully segregated, modular multitier arrangement with adequate size and distinct cable alley, bus bar alley/chamber (form-3b Construction). The panel shall be complete with name plate, earthing, numbering, danger plate etc. as required and as per specifications and drawings. The panel shall withstand the fault level of as indicated elsewhere or shown in Single Line Diagrams.
	Important Notes: Common for all Switchboard:
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1	The BOQ shall be read inconjunction with general notes, specification and Single Line Diagram (attached for Ref.). Incase of any discrepancy between specification, BOQ and SLD, the same shall be brought to the notice of Client/Consultant before quoting the rates, otherwise stringent condition shall be deemed to have been considered.
2	Fault current wherever mentioned shall be Ics value. (Ics = 100% Icu).
3	All MCCB shall be provided with door interlocked rotary handle with ON/TRIP/OFF position indicator, continious variable thermal magnetic O/C and S/C releases. The MCCB above 250A rating shall be provided with microprocessor based releases.
4	Incoming MCCBs shall be provided with O/C, selective S/C, Instentaneous short circuit protection releases.
5	Outgoing MCCBs shall be provided with O/C, and selective short circuit protection.
6	All feeder doors shall have pad locking arrangement.
7	All TP feeders shall have solid isolable neutral link.
8	All MCCB used in starter feeder shall be suitable for motor duty application.
9	All power contactors including NIC shall be of AC3 duty.
-	-
10	Panel shall be powder coated of approved shade with minimum 60 micron thickness.
11	Size of Voltmeter/ Ammeter for incomer also, 96mm x 96mm flush mounted with shrouded terminal shall be used in the panel.
12	Bus bar chamber shall be kept at top of the all panels.
13	All bus bar shall be insulated with coloured PVC Sleeve i.e.RYB, BK as per colour code.
14	Internal wiring of panel shall be with size 2.5sqmm Flexible Copper Conductor for CT circuit and control wiring with 1.5 sqmm.
15	All indicating light shall be LED type .
16	Each vertical section of floor mounted panel shall have independent base frame (75mm x 40mm) size made out of 3 mm sheet steel (LT Panel & DG Panel).
17	All the makes shall be as per approved make list only.
18	Wherever only voltmeter & ammeter are required, the same may be provided in combined meter suitable for both parameter.
19	Space heater shall be provided in each cable alley.
20	All links/drops for ACB/MCCB shall be designed for full rated current of ACB/MCCB rating at same current density of Main Bus Bar.
21	All switchgear used in starter feeder shall be type-2 co-ordinated. Vendor is required to submit manufacturer's type-2 co-ordination chart for the make used.

22	Arch flase Protection shall be in Cable alley & busbar Chember.
23	Fault rating of RCCB shall be equal to the fault rating of MCBs.
24	Necessary Co-ordination shall be done by the Panel Manufacturer/ Vendor with the vendor of "Gas flooding system" for fire protection, for making suitable provisions in the panels, at the Design stage, Manufacturing stage, stage of testing at works & stage of commissioning at site.
1.0	RESIDENT HOSTEL/GUEST HOUSE PANEL
	Incomer :
	2 Nos. 630A 4P MCCB (35KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 600A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	800A TPN Al. Busbar of short circuit withstand capacity 50kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 35kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	12 Nos. 63A 4P MCCB.
	2 Nos. 100A 4P MCCB.
2.0	LIFT PANEL-GUEST HOUSE/RESIDENCE HOSTEL
	Incomer :
	1 Nos. 100A 4P MCCB (36KA)
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 100A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	150A TPN Al. Busbar of short circuit withstand capacity 36kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 36kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	6 Nos. 40A 4P RCBO.

3.0	MDB (L+P)
	Location: G.FL.
	Incomer :
	1 Nos. 100A 4P MCCB
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 200A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	315A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 25kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	2 Nos. 40A 4P MCB.
	2 Nos. 63A 4P MCB.
4.0	MDB (L+P)
	Location: 1st.FL. (Typical to 6F)
	Incomer :
	1 Nos. 160A 4P MCCB
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 150A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	200A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 25kA breaking capacity and shall be provided with ON/OFF/ Trip indication lamps with back up SP MCB.
	4 Nos. 40A 4P MCB.
	6 Nos. 63A 4P MCB.
5.0	MDB (L+P)
	Location: 7th.FL.
	Incomer :

	1 Nos. 160A 4P MCCB
	One (1) No. digital multifunction meter for measurement of voltage and currents with selector push buttons and one set of CT's of ratio 150A/5A, CL 1.0, 15 VA.
	3 Nos. phase indication lamps and 3 Nos. status indication lamps for ON/OFF/ Trip with control SP MCB.
	Busbar :
	200A TPN Al. Busbar of short circuit withstand capacity 25kA. Busbar shall be insulated with heat shrinkable sleeves and shall be color coded.
	Outgoing :
	All outgoing feeders shall be of 25kA breaking capacity and shall be provided with ON/OFF / Trip indication lamps with back up SP MCB.
	4 Nos. 25A 4P MCB with DOL starter for 1.1 to 2.2 kW.
	4 Nos. 40A 4P MCB.
	5 Nos. 63A 4P MCB.
V.	SUB HEAD - V : CABLES & CABLE TRAYS
1.0	Supply, loading, transportation unloading at site, storages at site, shifting from storage place to site of following sizes of XLPE insulated PVC sheathed, FRLS, Aluminium conductor armoured power cable of 1.1 KV grade conforming to IS amended upto date and as per specifications.
(i)	3½ X 50 sq. mm
(ii)	3½ X 35 sq. mm
(iii)	4 X 6 sq. mm
(iv)	4 X 25 sq. mm
2.0	Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed/ XLPE aluminium conductor cable of 1.1 KV grade as required.
(i)	3½ X 50 sq. mm (35 mm)
(ii)	3½ X 35 sq. mm (32mm)
(iii)	4 X 10 sq. mm (25 mm)
(iv)	4 X 25 sq. mm (28mm)
3.0	Supplying and installing following size of perforated Hot Dipped Galvanised Iron tray (Galvanisation thickness not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.
(i)	150 mm width x 50 mm depth x 1.6 mm thickness
	TOTAL OF CABLES & CABLE TRAYS
VI.	SUB HEAD -VI : LV SYSTEM LOW SIDE (TELEPHONE, TV & Wi-Fi SYSTEM)
A.	TELEPHONE SYSTEM:

1.0	Supply and installation of plug - in type socket outlet with G.I outlet box and cover plate complete as required in 3 module plate.
a)	RJ - 45
2.0	Supply, fixing, testing & commissioning of Modular RJ-11 telephone outlets with grid & cover plate in suitable size of 16 SWG GI box.
3.0	Supply and laying of 4 Pair UTP Cable 23 AWG copper with integral cross-member pair separator (bidirectional tape, strips and others will not be accepted) (Cat-6) standards for physical and electrical specifications. (Only for telephone & Wifi outlet)
a)	Cat 6 cable
4.0	Supplying and laying in position as desired by Project Manager of following sizes of heavy duty PVC conduit on surface/recess including, fish wire cutting/filling chases along with conduit accessories etc. complete as required for TV outlet to ONT inside apartment and ONT to LV shaft.
a)	20 mm dia heavy duty PVC conduit
b)	25 mm dia heavy duty PVC conduit
B)	TV SYSTEM
1.0	Supply and installation of 1.2mm thick GI Box with cover plate complete with all accessories as required.
2.0	Supplying and fixing 250x150x75 mm deep, 1.6 mm thick G I Junction box with coverplate complete as per site requirement. (To be installed above ONT for loose wire)
C).	Wi-Fi SYSTEMS
1	Supply, Installation, Testing & Commissioning of the Microservices based WLAN Architecture. The indoor AP should have radios to support 2.4Ghz and 5 Ghz band in a 4X4:4 Mu-MIMO configuration with support for 802.11 a/b/g/n/ac. The AP should have internal Omni Antennas and should support vBLE and RF optimization. It should also support way finding and asset tracking via bluetooth.Should support Artificial Intelligence platform, WIPS/WIDS to detect Rogue APs and the facility to terminate connection to the Rogue APs.Plenum rated and support for UL 60950-1 CAN/CSAC22.2 No. 60950-1, FCC Part 15.247, 15.407, 15.107, and 15.109 RSS247 ICES003.
2	Supply, Installation, Testing & Commissioning of Appliance Server based customised ITAM for asset inventory management with ability to map physical locations and exact rack elevations for audit and support control. Appliance shall be Intel x86 based device with secure intranet server with Linux Based operating system and relational databases for long term storage. Appliance includes license for 500 units under control.
TOTAL OF LV SYSTEM LOW SIDE (TELEPHONE, TV & Wi-Fi SYSTEM)	
VII.	SUB HEAD -VII : IP CCTV SYSTEM
1	Supply, Installation, Testing and commissioning of Cat6 23 AWG Solid Copper Conductor UTP LSZH Cable roll of 305 Mtr, in accordance to IEC 60332-2-33, ANSI/TIA 568 C.2, UL 444, IEC 60754 -1,2 & 3, IEC 60134-2 and ISO/IEC 11801-2nd Edition, 250 Mhz tested and UL & ETL Listed Cable, Grey, RoHS Certified for Connectivity of Hub room to End Point.

2	Supply, Installation, Testing & Commissioning of CAT6 UTP JACK, Universal (tool/toolless), As per ANSI/TIA 568 A/B wiring system, UL & ETL Verified- Blue for Camera at user end.
3	Supply, Installation, Testing & Commissioning of loaded 24-Port 1U loaded Universal Modular Straight Patch Panel, pre loaded with cable support Bar, Individual port transparent shutter and labelling point, Preloaded earthing plug for surge protection. UL & ETL Verified. CRC Metal with Black Powder Coated. RoHS Compliant, in accordance to ANSI/TIA-568-C.2, ISO/IEC 11801:2002/AMMD.2:2010, YD/T 926.3-2009, ISO/IEC 60603-7 standards. Saftey parameters as per UL 94V-0, at rack end.
4	Supply, Installation, Testing & Commissioning of Cat6 UTP 24AWG, Stranded Flexible, LSZH Jacket , in accordance to ANSI/TIA 568C.2 Patch Cord, Complying to UL94-V-0 BLUE 1 Mtr for rack side switch to jack panel connectivity.
5	Supply, Installation, Testing & Commissioning of Cat6 UTP 24AWG, Stranded Flexible, LSZH Jacket, in accordance to ANSI/TIA 568C.2 Patch Cord, Complying to UL94-V-0 BLUE 2 Mtr for rack side switch to jack panel connectivity.
6	Supply, Installation, Testing & Commissioning of 1/2/ 4 Port British Style Spring Shutter Face Plate with elegant 2 Piece design ABS-UL94-V2, 86x86x12.8 (mm). Straight white for I/O fixing at user side.
7	Supply, installation, testing and commissioning of Dome Camera , (as per details specification).
8	Supply, installation, testing and commissioning of Bullet Camera , (as per details specification).
9	Supply, installation, testing and commissioning of 64 channel NVR, ONVIF compliant, recording bandwidth 640 Mbps, output interface 1 HDMI (up to 4K), 1 VGA, Alarm in/out :16ch in/ 4ch out , 1 X RJ45 ethernet , iOS smartphone support, 8 HDD support , each HDD slot support upto 8 TB HDD, RAID support , 1x3.0 USB for backup /upgrade , 2x 2.0 USB for mouse. Edge analytics of poposed cameras must be integrated with NVR . Artificial Intelligence Support having face recognition with compatible deep learning supported cameras, AI-Face registered quantity upto 10,000 ,A.I maximum captured quantity 200,000. UL,CE,FCC certified.
10	Supply, Installation, Testing & Commissioning of 8TB Surviellance Hard Disk.
11	Supply, Installation, Testing and Commissioning of Full HD 55" LED Professional Display Panel.
12	Supply, Installation, Testing and Commissioning of Rack Mounted Industrial 24 port L2+ Managed switch having 24*10/100/1000Base-T POE ports, 4*100/1000Base-X uplink SFP ports, 1*RS232 Console port. Forwarding Rate @ 64 byte 38.69Mpps .Operation TEMP/ Humidity -40~+85°C.
13	Supply, Installation, Testing and Commissioning of Core Switch with 1*USB 2.0 port, 24*1/10G SFP+ fiber ports (Data), 1*RS232 Console port(9600,8,N,1), 4*40G/100G QSFP28 fiber ports (Data)1*10/100/1000M RJ45 management port(Data), Forwarding Rate @ 64byte 952Mpps. Operation TEMP/ Humidity -20 to +55°C.

14	Supply, Installation, Testing and Commissioning of Workstation PC: Intel(R) Core(TM) i7-3770 Processor (8M Cache, up to 3.90 GHz); RAM: 8GB (1x8GB) Non-ECC DDR3 1600MHz ; Keyboard: 12 function keys; Chassis: Tower/Workstation; DVD: 8X Slimline DVD+/-RW, Data Only; Dual Graphics Card; Network interface card: Integrated Intel(R) 82579LM Gigabit1 Ethernet LAN 10/100/1000; Hard disk: 250GB, 7200 RPM 3.5" SATA 6Gb/s Hard Drive; Operating system: Windows 7 Professional 64 Bit or latest.
	TOTAL OF IP CCTV SYSTEM
VIII.	SUB HEAD - VIII : FIRE DETECTION AND EVACUATION SYSTEM
I.	FIRE DETECTION SYSTEM
1	FIRE ALARM CONTROL PANEL
	Supplying, installation, testing and commissioning of micro processor based intelligent addressable main fire alarm panel, central processing unit with the following loop modules and capable of supporting not less than 240 devices (including detectors) and minimum 120 detectors per loop and loop length up to 2 km, network communication card, minimum 320 character graphics/ LCD display with touch screen or other keypad and minimum 4000 events history log in the non volatile memory (EPROM), power supply unit (230 ± 5% V, 50 hz), 48 hrs back-up with 24 volt sealed maintenance free batteries with automatic charger. The panel shall have facility to connect printer to printout log and facility to have seamless integration with analog/digital voice evacuation system (which is part of the schedule of work under SH: Evacuation System) and shall be complete with all accessories. The panel shall be compatible for IBMS system with open protocol BACnet/ Modbus over IP complete as per specifications.
a.	One Loop
2	Supplying, installation, testing & commissioning of central graphical fire alarm management system to centrally monitor and operate the fire alarm system complete as required.
3	Supplying, installation, testing & commissioning of repeater panel with 320 character/ Touch screen LCD display with inbuilt reset, acknowledge and silence switches complete as required.
4	Supplying, installation, testing & commissioning of intelligent analog addressable photothermal detector / multicriterion detector complete with mounting base complete as required.
a.	Below False Ceiling
b.	Above False Ceiling
5	Supplying, installation, testing & commissioning of response indicator on surface/ recessed MS Box having two LED, metallic cover complete with all connections etc as required.
6	Supplying, installation, testing & commissioning of fault isolator complete with base as required.
7	Supplying, installation, testing & commissioning of intelligent addressable thermal detector with rate of rise cum fixed temperature thermistor complete with base as required.

8	Supplying, installation, testing & commissioning of addressable fire control module complete as required.
9	Supplying, installation, testing & commissioning of addressable beam detector with short circuit isolator (inbuilt or separate) complete with emitter and receiver including connections with remote test features etc. complete as required.
10	Supplying, installation, testing & commissioning of addressable manual call point complete as required.
11	Supplying, installation, testing & commissioning of addressable horn cum strobe complete as required.
12	Supplying, installation, testing & commissioning of fire fighter telephone handset complete as required.
13	Supplying, installation, testing & commissioning of intelligent interface unit BACnet/Modbus protocol i.e. supplying communication links between building management system and fire alarm control panel complete as required.
14	Supplying, installation, testing & commissioning of fire fighter phone jack complete as required.
15	MONITOR MODULES
	Supply, Installation, Testing & Commissioning of Addressable Monitor Module for Sprinklers, Panic Bars & other Third Party Inputs. The monitor module shall monitor potential free contacts. The device shall have an LED which shall blink in normal state & get steady on activation to monitor the health status of the device. Addressing shall be with user friendly rotary decimal switches. Module shall be supplied with mounting plate from OEM for ease of installation & maintenance UL & FM Approved.
16	Supply, installing, testing and commissioning of Addressable Relay Module for AHU, Access Control, Lifts, Staircase Pressurization, Fire Suppression & other Third Party Outputs. The relay module shall provide contact rated at 24v DC, 2A. The device shall have an LED which shall blink in normal state & get steady on activation to monitor the health status of the device. Addressing shall be with user friendly rotary decimal switches. Module shall be supplied with mounting plate from OEM for ease of installation & maintenance UL & FM Approved.
14	Supplying & laying of 2x1.5 sqmm fire survival armoured cable, 600/1000V rated with annealed copper conductor having glass mica fire barrier tape covered by an extruded layer of Cross Linkable Ethylene Propylene Rubber (EPR) insulation and LSZH inner bedding, steel wire armouring & LSZH outer sheath complete as required.
15	Supply, Installation, testing and Commissioning of Exit Signage Light with 3hrs Battery Backup Twin Side available in Green/Red Colour.
IX.	SUB HEAD - IX : LIGHTNING PROTECTION
1.0	LIGHTNING PROTECTION
1.1	Fixing clamp for (1500 mm) air terminal, DEHN Part No. 306029

1.2	Air Terminal 1.5 mtr. side wall, DEHN Part No.104250
	Clamp for holding 1.5 mtr. air terminal on wire fence
	Clamp for connecting air terminal rod to 8mm Conductor, DEHN Part No. 380116
1.3	Universal Clamp, DEHN Part No. 315119
1.4	Al Round Conductor on roof (Ø 8mm), Dehn Part No. 840008
	Al Round Conductor Holder for wall with accessories wall plug & screw, Dehn Part No. 274150
1.5	Al Down Conductor (Ø 8mm), Dehn Part No. 840008
	Al Down Conductor Holder for wall with accessories wall plug & screw, Dehn Part No. 274150
1.6	Test Clamp, Dehn Part No. 459139
1.7	GI Strip for Down Conductor to earth (25x6 mm)
1.8	GI Strip holder (25x6 mm)
1.9	17.2 mm Copper bonded UL listed rod of 3 mtr length
1.10	Environment friendly, RoHS certified, low resistivity Ground Enhancement material in 22.6 Kg pack to fill the bore area around the rod.
1.11	StSt 316 grade clamp to terminate the load on earth electrode
1.12	Poly Plastic Pit Cover
1.13	GI Strip 25x6mm for Interconnecting Earth Pits
	TOTAL OF LIGHTNING PROTECTION
X.	SUB HEAD - X : ELEVATORS
1.0	PASSENGER LIFT (G+6)
	Design Manufacture, Supplying delivery at site, Installation, Testing & Commissioning of Machine Room Less Gearless Elevator (Regenerating Type) in Shaft of dimensions 2150 mm x 2950 mm (W x D) for minimum payload carrying capacity of 16 passenger/ 1088 kg serving different floors as per specifications as under:-
	Location of Lift : GUEST HOUSE + RESIDENT HOSTEL (As per Lift Shedule)
2.0	PASSENGER LIFT (G+6)
	Design Manufacture, Supplying delivery at site, Installation, Testing & Commissioning of Machine Room Less Gearless Elevator (Regenerating Type) in Shaft of dimensions 1900 mm x 2150 mm (W x D) for minimum payload carrying capacity of 10 passenger/ 680 kg serving different floors as per specifications as under:-
	Location of Lift : GUEST HOUSE + RESIDENT HOSTEL (As per Lift Shedule)

LIST OF APPROVED MAKES

ELECTRICAL WORKS INTERNAL & EXTERNAL, HIGH SIDE SUBSTATION, MEDIUM VOLTAGE, LOW VOLTAGE, DG SETS, UPS, FIRE ALARM SYSTEM, CCTV, ACCESS CONTROL, SOLAR PV, LIFTS

LIST OF APPROVED MAKES (Electrical)

S.No.	EQUIPMENT	APPROVED MAKES
	SUB-STATION WORKS	
1.	33 KV VCB Panel (OEM)	Siemens/ ABB/ Schneider
2.	Transformers (Oil Type)	ABB/ Schneider/ Voltamp/ Kirloskar/ Crompton Greaves/
3.		
4.	33 KV H.T. Cables	Universal/ Polycab/ KEI/RR Kabel/ Finolex/ Gloster/ Havells
5.	L.T. Cables	Universal/ Polycab/ KEI/RR Kabel/ Finolex/ Gloster/ Havells
6.	H.T. Cable Jointing Kits	Raychem/ 3M/ Xicon
7.	Air Circuit Breakers	Siemens/ Lauritz Knudsen (formerly L&T)/ Schneider/ ABB
8.	Moulded Case Circuit Breakers	Siemens/ Lauritz Knudsen (formerly L&T)/ Schneider/ ABB/ Legrand
9.	MCBs/RCCB/DB/V TPN DB	Legrand/ Siemens/ ABB/ Schneider/ Hager/ Havells/ Lauritz Knudsen (formerly L&T)
10.	Selector Switches	Switron/ BCH/ Lauritz Knudsen (formerly L&T)/ ABB/ Siemens/ Schneider
11.	Contactors	Siemens/ ABB/ Lauritz Knudsen (formerly L&T)/ Siemens/ Schneider
12.	Multifunction Meter	Conzerv / ABB/Siemens/ Schneider Electric/ Lauritz Knudsen (formerly L&T)
13.	Digital Panel Meters	Conzerv / ABB/Siemens/ Schneider Electric / Lauritz Knudsen (formerly L&T)
14.	Indicating Lamps (LED type)	Siemens / Schneider/ Lauritz Knudsen (formerly L&T)/ ABB
15.	Push Buttons	Siemens/ Teknic/ GE/ C&S/ Schneider/ Lauritz Knudsen (formerly L&T)
16.	Hybrid APFC Panel	Lauritz Knudsen (formerly L&T)/ ABB/ Schneider/ Siemens/P2 Power
17.	ATS	ASCO/ Russelectric / Siemens

S.No.	EQUIPMENT	APPROVED MAKES
		/ Caterpillar/ SOCOMEC
18.	Connectors/ Terminal Blocks	Elmex/ Connectwell / Essen/ SCHNIEDER/ Lauritz Knudsen (formerly L&T)
19.	Main LT (TTA) Panel (OEM or OEM Authorised Licensee partner)	Siemens/ Schneider/ Lauritz Knudsen (formerly L&T)/ ABB
20.	Sub Panels/ HVAC Panels/ Feeder pillar and any other panel, Capacitor Panel/ Synchronization/ load management panels as per Technical Specification (PTTA PANELS)	Siemens/ ABB/ Schneider/ Lauritz Knudsen (formerly L&T) or their licensed channel partners.
21.	Insulation Mats	ISI marked
22.	Numerical Relays	Schneider Electric/ ABB/ Siemens/ Lauritz Knudsen (formerly L&T)
23.	TVSS	Emerson/ Indelec / Tarcel / Schneider
24.	Compact Busbar Trunking & Rising Main	Schneider/ Siemens/ Legrand/ ABB/ Lauritz Knudsen (formerly L&T) / C&S
25.	OT Isolation panel	Schneider/ ABB/ Bender/ BPC(UK)

S.No.	EQUIPMENT	APPROVED MAKES
	INTERNAL ELECTRICAL WORKS	
1.	Power/ Aux. Contractor 3/ 4 Pole	Schneider Electric/ ABB/ Lauritz Knudsen (formerly L&T)/ Legrand/ Siemens/ Havells
2.	Indicating Lamps LED type, Push Button	Schneider Electric/ Vaishno Electricals/ Lauritz Knudsen (formerly L&T)/ Siemens
3.	Ceiling Fans/ Exhaust Fans	Havells/ Crompton/ Orient
4.	GI Pipes	Jindal Hissar/ Prakash Surya/ Tata/ Sail
5.	Light Fixture	Philips/ Wipro/ LT
6.	Polycarbonate Junction boxes	Hensel/ Clipsal/ Mennekes/ Schneider
7.	External Light Poles	Keselecc-Classic/ Valmont/ Bajaj/ NEZONE
8.	External Lights	Philips/ Wipro/ LT/ K-LITE
9.	Overload relays with built in Single Phase Preventer	Schneider Electric/ ABB/ Lauritz Knudsen (formerly L&T)/ Siemens
10.	Electronic Digital Meters (A/V/PF/HZ/KW/KWII) (Networkable)	Conzerv/ Schneider Electric/ Lauritz Knudsen (formerly L&T)/ Secure
11.	XLPE insulated PVC sheathed copper conductor Armoured power cable of 1.1 KV grade	Universal/ Polycab/ KEI/RR Kabel/ Finolex/ Gloster/ Havells
12.	Lighting Arrestor/ Surge Arrestor/ SPD	Dehn/ OBO/ Furse/ Schneider/ Teksai
13.	LT Jointing Kit/ Termination	Raychem/ M Seal
14.	Cable Glands Double Compression with Earthing Links	Comet/ Cosmos/ Dowell
15.	Bimetallic/ Copper/ Aluminium Cable Lug	Comet/ Dowell's (Biller India Pvt.

S.No.	EQUIPMENT	APPROVED MAKES
		Ltd.)/ Hax Brass (Copper Alloy India Ltd.)
16.	PVC insulated copper conductor stranded flexible FRLS wire (pre twisted)	Polycab/ KEI/RR Kabel/ Finolex/ Havells
17.	MS Conduit (ISI approved)	AKG/ BEC/ RMCON/ NIC
18.	PVC Conduit & Accessories	POLYCAB/ BEC/ AKG/ RISHA/ WELKM/ PRESTO PLAST
19.	Switch Socket Accessories	Legrand (Arteor)/ Crabtree (Athena)/ MK (Blenz)/ Panasonic (Europa)
20.	Cable Trays/ Raceways (Prefabricated)	Profab Engineer/ RMCON/ Ricco/ Slotco/ True Leader/ AKG
21.	Rubber Mats (ISI Mark)	Jyoti/ Premier/ Insulatica 2000
22.	Fastners	Hilti/ Fisher
23.	Paints	ICI/ Asian/ Berger
24.	Fire Sealent	Promat/ Hilti/ Birla - 3 M
25.	Cat-6A Cable, Wires & Fiber Optic Cable	SYSTIMAX/ PANDUIT/ BELDEN/ SIEMON
26.	Selector Switch, Toggle Switch	Lauritz Knudsen (formerly L&T)/ Siemens/ Kaycee
27.	Timer	Siemens/ Lauritz Knudsen (formerly L&T)/ Schneider Electric-TE
28.	Material for Structure	Tata/ Jindal/ Sail

S.No.	EQUIPMENT	APPROVED MAKES
	DG SET WORKS	
1.	DIESEL ENGINE	Cummins/ Perkins/ Caterpillar
2.	Alternator	Stamford/ Leroy Somers
3.	Digital Panel Meters/ Electronic Load Manager	Conzerv / Krykard / Enercon/ Neptune/ Lauritz Knudsen (formerly L&T)
4.	Indicating Lamp (Led Type)/ Push Buttons	SIEMENS/ Lauritz Knudsen (formerly L&T)/ TEKNIC
5.	Selector Switch	Lauritz Knudsen (formerly L&T)/ GE/ Kaycee/ AE/ IMP/ Rass Control/Salzer
6.	CT'S	AE/ KAPPA/ C&S
7.	CABLE LUGS	Dowell/ Multi
8.	M.S PIPES	TATA/ Jindal (Hisar).
9.	TOOLS	Taparia, Gedore

S.No.	EQUIPMENT	APPROVED MAKES
	UPS WORKS	
1.	UPS (including Isolation, AHF and Static Switch)	APC/ Vertiv / Toshiba- Mitsubishi (Tmeic) / Numeric/ EATON/ SOCOMEC

FAS AND INTEGRATED VOICE EVACUATION SYSTEM

S. No.	Item Description	Manufacturer
1.	Addressable Fire panel, DVC and Annunciators, Digital Amplifier	NOTIFIER /BOSCH UL/ JOHNSON CONTROL/ SIEMENS/ ESSER
2.	FAS Software and gateways	NOTIFIER /BOSCH UL/ JOHNSON CONTROL/ SIEMENS/ ESSER
3.	Addressable type Detectors, Addressable Beam detectors and Addressable Very Early Warning Aspiration detector	NOTIFIER /BOSCH UL/ JOHNSON CONTROL/ SIEMENS/ ESSER
4.	Addressable Devices and Modules.	NOTIFIER /BOSCH UL/ JOHNSON CONTROL/ SIEMENS/ ESSER
5.	Notification Devices, Speakers	BOSCH/ HEINRICH/ASL/ BIAMP/ TANNOY/ TURBO SOUND
6.	Telephone Talk back system	NOTIFIER /BOSCH UL/ JOHNSON CONTROL/ SIEMENS/ ESSER
7.	Fire survival cables (as per specification)	AFW/ FRTEK / PRYSMIAN/ WREXHAM/ NVENT
8.	All other items not covered above	As per Approval of Engineer In Charge.

S. No.	EQUIPMENT	APPROVED MAKES
	ACCESS CONTROL SYSTEM	
1.	Door controller, Card reader, Biometric reader, Access control, Server software smart card	SMART-I / SCHNEIDER/ UTC/ BOSCH/ HID/ LENEL/ IDCUB MERCURY, HONEYWELL - TEMALINE, TYCO - SOFTWAREHOUSE, (Subject to availability of service centre in Guwahati)
2.	E-magnetic Lock	Cisa/ Faraday/ Trimec (Subject to availability of service centre in Guwahati)
3.	Boom Barrier	Ravel/ Magnetic/ Came/ Skidata/ Elka/ Automatic Systems (Subject to availability of service centre in Guwahati)
	EPABX & NETWORKING WORKS	
1.	Passive components Cat-6A Cable, Wires & Fiber Optic Cable	SYSTIMAX/ PANDUIT/ BELDEN/ SIEMON
2.	Data Switches, receiver, media converter	CISCO/ EXTREME/ HP/ ALCATEL-LUCENT/ JUNIPER
3.	IP Based EPABX System	CISCO/ AVAYA/ ALCATEL-LUCENT/ HP/ TADIRAN (Subject to availability of service centre in Guwahati)
4.	Equipment Rack	APW PRESIDENT/ HCL/ RITTAL/ VALRACK/ MTS

S.No.	EQUIPMENT	APPROVED MAKES
1. 1	CCTV camera/ Bullet camera/ Dome Camera/ PTZ camera and NVR	BOSCH/ PELCO/ AVIGILON/ AXIS (Subject to availability of service centre in Guwahati)
2. 2	LED Display Monitor	LG/ SONY/ SAMSUNG
3. 3	Network Switch	CISCO/ EXTREME/ HP/ ALCATEL-LUCENT/ JUNIPER
4. 4	CAT 6A cable & related accessories (Should be supported to cat 6A network)	SYSTIMAX/ PANDUIT/ BELDEN/ SIEMON
5. 5	Fiber optic cable, LIU, etc. all related accessories	SYSTIMAX/ PANDUIT/ BELDEN/ SIEMON
6. 6	All other items not covered above	As per approval of Engineer-in-charge.

S.No.	Equipment	Approved Makes
	AV and Control system for seminar/ Board/ conference rooms	
1.	Loudspeakers	BOSE/ L-ACCOUSTICS/ D&B AUDIO TECHNICA/ HEINRICH/ TANNOY
2.	Amplifier	BOSE/ LABGRUPPEN/ POWERSOFT /HEINRICH/ BEHRINGER (Subject to availability of service centre in Guwahati)
3.	Microphones	BEYERDYNAMIC/ SENNHEISER/ HEINRICH/ SHURE/ AUDIO TECNICA
4.	Mixer	BEHRINGER/ AUDIO TECNICA/ MARTIN AUDIO/ / YAMAHA/ HEINRICH (Subject to availability of service centre in Guwahati)
5.	Projector	EPSON/ CHRISTIE/ PANASONIC/ BARCO/ SONY (Subject to availability of service centre in Guwahati)
6.	PROJECTOR SCREEN	LIBERTY/ STAR SCREEN/ SUVIRA (Subject to availability of service centre in Guwahati)
7.	Conference controller with chairman delegate units	TELEVIC/ BXB/ SENNHEISER/ HEINRICH/ POLY/ CISCO/ PANASONIC (Subject to availability of service centre in Guwahati)
8.	LCD/ LED screens	SAMSUNG/ SONY/ LG
9.	Video Switching and distribution with HDMI cables and Rx-Tx	Crestron/ AMX/ Kramer/ Heinrich (Subject to availability of service centre in Guwahati)
10.	Video Conferencing unit	AVAYA/ CISCO/ GRAND STREAM/ HEINRICH/ POLYCOM/ PANASONIC (Subject to availability of service centre in Guwahati)
11.	55/65/75 Digital Signage with signage software	LG/ Planer/ Barco

SOLAR PV GENERATION

S. No.	EQUIPMENT	APPROVED MAKES
1.	Solar PV Modules	Schneider/ Moser Baer/ Tata BP Solar/ CEL/ BEL/ Reliance/ GE Solar/ Sanyo/ PCI/ WAAREE
2.	Power Control Unit (PCU) String PCU	Emerson/ Mitsubishi/ Delta/ Schneider/ WAAREE (Subject to availability of service centre in Guwahati)
3.	Solar Inverter	Delta/ Neowatt/ Schneider/ WAAREE (Subject to availability of service centre in Guwahati)
4.	MC4 Connector	Synergy/ Stellar/ Schneider/ WAAREE
5.	Solar hybrid inverter	Microtech/ Luminous/ Solex/ Enertek/ WAAREE (Subject to availability of service centre in Guwahati)
6.	Module mounting Structure	As per MNRE/ Manufacture's standard

S. No.	EQUIPMENT	APPROVED MAKES
1.	Lift	KONE/ SCHINDLER/ JOHNSON/ OTIS/ MITSUBISHI / THYSSENKRUPP (Subject to availability of service centre in Guwahati)

PART – 4
MECHANICAL WORKS

SCOPE OF WORK

AC Plant Room & Service Buildings

Centralized Chilled Water Air Conditioning System being considered for Hospital and R & D Center Blocks. Hot Water Generators will be used for monsoon reheat of critical areas like areas (such as OT, ICU, CCU, PICU, Pre-operation, Post-operation, radiology, labs & NICU) etc. All critical areas will have 4 pipe system (separate cooling & heating pipe network) & balance area's AHU will be with 2 pipe system (to provide cooling as well as comfort heating by using switch over mode through hot water generator).

TTA MV Motor control HVAC panel, Aluminium XLPE armored cable from TTA LT cum Emergency Panel to HVAC Panel, Cabling from HVAC Panel to Chiller, cabling from HVAC Panel to Pumps, Cooling Towers, HWG etc.

	Proposed Central Plant Capacity	Except OTs	OTs	Remark
1	Water Cooled Chiller capacity	4x 475TR (3W+1S) Centrifugal	1x 125 TR (1W) Screw	Common standby
2	Cooling tower (@3GPM/TR)	4 Nos. 17,95,952 K.CAL/Hr (3W+1S)	1x4,72,619 K.CAL/Hr (1W)	Common standby
3	Primary Variable Pumps (@2.4GPM/TR OTs & @2GPM/TR except OTs)	4 Nos. 950 USGPM (3W+1S)	2 Nos. 300 USGPM (1W+1S)	
4	Condenser Water Pumps (@3GPM/TR)	4 Nos. 1425 USGPM (3W+1S)	2 Nos. 375 USGPM (1W+1S)	
5	Electric Hot Water Generator (Space Heating)	3 Nos. 350 KW (2W+1S)	-	
6	Electric Hot Water Generator (Monsoon Reheat)	3 Nos. 120 KW (2W+1S)		
7	Hot Water Pumps with VFD(Monsoon Reheat)	3 Nos. 90 USGPM(2W+1S)		

For OTs & sterile corridor separate chiller to be provided.

The chilling machines shall be AHRI/ Eurovent certified with eco-friendly refrigerant, Cooling tower shall be CTI Certified, Fans shall be AMCA certified for fan efficiency & Noise, Fire dampers shall be UL certified preferably with FM certification also.

Chilled Water System screw Chiller with VFDs & AHF are proposed for Summer/Monsoon Cooling for OTs, Cath Labs & sterile corridor however water cooled centrifugal chillers shall be considered for rest areas.

For re-heat system hot water generator and hot water pumps shall be placed in plant room.

All Primary Variable Chilled Water Pumps will be with unit mounted Variable Speed Drives circulating water in the chilled/hot water circuit.

Provision of specialized equipment like Air and Dirt Separator in the Plant Room to ensure smoother operation, enhanced efficiency of system and longevity.

Chilled Water Circuit comprising of MS pipes ("C" Class) with Groove Fittings and with suitable Insulation as per Technical specification.

Condenser Water Circuit comprising of MS pipes ("C" Class) with Groove Fittings without Insulation.

Pressurized Expansion Tank to adjust and regulate the pressure of water in the Chilled and Hot Water Circuit shall be provided.

CTI certified Cooling Tower with VFD driven Fan Motors for Chilled Water System.

Chilled Water flow Modulation by means of Manual/Motorized Butterfly, Non Return Valve, Ball Valve, Balancing Valve, Y-strainer, with insulation. All the valves must be minimum PN16 rated and suitable for Chilled Water and Hot Water applications. Insulation of valves shall be the same as that of pipe.

Condenser Water flow Modulation by means of Manual/Motorized Butterfly, Non Return Valve, Ball Valve, Balancing Valve, Y-strainer, Pot strainer. All the valves must be minimum PN16 rated and suitable for condenser Water applications.

The scheme of colour code painting of pipe work services for AC installation shall be as per NBC/CPWD specifications.

Automatic controlled Tube cleaning system to be provided.

Electro- Chemical System Cooling Towers

DX Split AC

Buried Pre-Insulated chilled/Hot water pipe line with HDPE jacketing from chiller plant to Individual buildings (Hospital and R&D buildings) as per GFC drawings and Technical specification.

Ventilation of service buildings.

Plant Optimizer shall be provided

BMS for high side (Plumbing, Fire Fighting, Electrical, soft integration of plant optimizer etc. as per IO summary)

Hospital Building

Central AC Plant-Capacity of HVAC system shall be based on heat load calculation of the hospital building but minimum capacity shall be as per Detail scope of work (External work)

- Integrated building management system in Hospital building for the operation, monitoring & controlling of complete electrical and mechanical services and AC plants etc. as per detailed specifications with recording, display, analysis, hardware and software for optimization of electrical load and energy conservation, and all parameters of all other E&M Equipments, Services, Utilities etc. along with cabling, display system and hardware and software support etc. complete as required.

For Critical Areas

All Critical Areas kept on air recirculation and outside air intake system as per standards specified by ASHRAE, NBC-2016, ISHRAE and NABH etc.

Two OTs considered for $18\pm 1^{\circ}$ C with RH 50% to 60%, at 100% fresh air. To achieve 18° C temperature AHU shall have enthalpy wheel, Descent wheel, chilled water cooling coil, re-heat coil, DX cooling coil connected to dedicate DX out door unit.

Rest all OTs inside condition will be $21\pm 1^{\circ}$ C with RH 50% to 60% with re-circulatory system.

All critical areas (such as ICU, CCU, Pre-operation, Post-operation, radiology & labs except NICU) is design @ $22\pm 1^{\circ}$ C inside temperature and RH 50% to 60%.

Rest all AC areas is design as per table given in design parameter.

Operation theatres and Cath labs: ASHRAE codes to be followed

All AHU for OTs shall be fitted with devices so that during periods of inactivity the air changes can be reduced as per the standards of ASHRAE.

Active humidity control is to be instituted in all operation theatres and cath labs.

Ventilation and Air Filtration to dilute and remove contamination in the form of odour, airborne microorganisms and viruses, hazardous chemical and radioactive substances. To ensure the same, UVGI System shall be considered. Magnehelic Gauges/ Electronic Pressure Gauges to be installed for critical areas for measuring differential pressure between zones.

High Efficiency Filtration system to prevent bacterial contamination whether it is from Outdoor Air or from re-circulated air within space.

Two Stage Filtration comprising of Electronic Air Filtration System (equivalent to MERV-14) and HEPA Filters for Critical Areas.

Pre-insulated CFC Free 'PUF/PIR' (Polyisocyanurate Foam) Panel/ Board shall be used for supplying & return air for all AC areas to reduce the risk of bacterial formation in the ducts.

For OTs, the Supply and Installation of HEPA Filters at Terminals, Laminar Flow Diffusers and Inside supply/return OT Ducting shall lie within the scope of Modular OT vendor.

All AHU & FCU shall have MERV-14 filtration with Electronic Air Filtration.

All AHU & Ducts shall have UVGI system to control spread of air borne infections.

Double & single bedded wards shall be feed through FCU having ESP (MERV-14) filter.

Fans for all OT's AHUs shall have N+1 configuration rest all AHU shall have N configuration.

Consultant Room, Waiting areas, class room, offices, conference room & meeting room shall have VAV boxes with thermostat for individual control.

Isolation Room

The P.E Isolation rooms have individual AHU with HEPA filters at terminal.

For A.I.I. Isolation rooms to be considered a once through air circulation philosophy (all air exhausted at terrace level with HEPA filter with 1W+1S exhaust fan) with the supply air being fed by the ICU Ward AHU, no return air is being taken from these rooms. Motorized volume control damper shall be provided at supply air tapping for A.I.I. isolation room and shall be integrated with exhaust fans placed at terrace, while exhaust fan switch off the supply air to isolation room get cutoff.

AC System

Centralized Chilled Water Air Conditioning System being considered for Hospital Block. Hot Water Generators will be used for monsoon reheat of critical areas like areas (such as OT, Cath-Lab, ICU, CCU, PICU, Pre-operation, Post-operation, radiology, labs & NICU) etc. All critical areas will have 4 pipe system (separate cooling & heating pipe network) & balance area's AHU will be with 2 pipe system (to provide cooling as well as comfort heating by using switch over mode through hot water generator).

Precession AC shall be considered for Server Rooms etc with N+1 configuration.

DX Split AC to be considered for UPS room.

All the equipments etc. shall be suitable for 415 V, three phases or 220 V, Single phase, 50 Hz A.C. supply.

Chilled Water Circuit comprising of MS pipes ("C" Class) with suitable Insulation in case of Centralized Chilled Water System.

Pipe fittings from 20 NB & Above shall be with Grooved joints.

GI pipes (Class B) for drain pipe with suitable insulation for chilled water system

Only Floor Mounted Air Handling Units (Eurovent certified for critical area AHUs & Non-certified for non-critical AHU), Fan Coil Units to Convey Chilled Air in case of Chilled Water System.

All AC Ducting System shall be Factory Pre Cut coated Pre-insulated (no-oxidation) PIR Panels GreenPro Certified, HCFC & CFC Free. Ducted supply and return both to be considered for all ac areas in Hospital.

Ventilation Ducting System comprising of GI Ducting. Duct Construction and suspension Standards must conform to SMACNA, IS 655.

Consultant Room, Waiting areas, class room, offices, conference room & meeting room shall have VAV boxes with thermostat for individual control.

Chilled Water flow Modulation by means of Manual/Motorized Butterfly, Non Return Valve, Ball Valve, Automatic Balancing Valve with insulation. All the valves must be minimum PN16 rated and suitable for Chilled Water and Hot Water applications. Insulation of valves shall be the same as that of pipe.

PIBCV shall be provided at AHU out let. The contractor shall provide the schedule of the basis of the selection PIBCV according to the equipment tag number.

Air Flow Modulation by means of Air Distribution devices like Volume Control Duct Dampers, Collar Dampers, CAV/VAV Boxes conforming to ASME and SMACNA Standards.

Colour scheme for equipment like Chillers/Pumps/AHUs/Cooling Tower etc. shall be as per manufacturer's standard color scheme or as per directions of E-I-C.

The scheme of colour code painting of pipe work services for AC installation shall be as per NBC/ CPWD specifications.

Provision of trap door of suitable material & size shall be considered for easy accessibility of moving parts of the concerned equipment/dampers.

BMS Compatibility to all Air Conditioning (3 phase equipment) High Side and Low Side Equipment.

Touch screen types central controller to be provide for guest house with provision to ingrate the same on BMS.

Heat recovery units (Plate Heat Exchanger Type) shall be provided.

RAL Colour of Grill, Diffuser, Cassette Unit, Louvers, any exposed item which is coming in the habitable spaces should be selected after confirmation from interior designer.

All OTs & Cath Lab AHUs shall have steam humidifier.

All AHUs shall have coil mounted UVGI.

Duct mounted UVGI to be considered for all critical areas (such as OT, Cath-Lab, ICU, CCU, PICU, Pre-operation, Post-operation, radiology, labs & NICU).

Air Curtain to be considered at main entrance.

Heating System

Comfort heating proposed for all areas of Hospital however Monsoon Reheating is to be considered for Critical Areas such as (OT, Cath-Lab, ICU, CCU, PICU, Pre-operation, Post-operation, radiology, labs & NICU).

R&D Building

Central AC Plant-Capacity of HVAC system shall be based on heat load calculation of the hospital building but minimum capacity shall be as per Detail scope of work (External work)

- Integrated building management system in R& building for the operation, monitoring & controlling of complete electrical and mechanical services and AC plants etc. as per detailed specifications with recording, display, analysis, hardware and software for optimization of electrical load and energy conservation, and all parameters of all other E&M Equipments, Services, Utilities etc. along with cabling, display system and hardware and software support etc. complete as required.

AC System

Centralized Chilled Water Air Conditioning System being considered for R&D Building. All AHU will be with 2 pipe system (to provide cooling only).

DX air-cooled split AC shall be considered for UPS Room etc with N+1 configuration.

All the equipments etc. shall be suitable for 415 V, three phases or 220 V, Single phase, 50 Hz A.C. supply.

Chilled Water Circuit comprising of MS pipes ("C" Class) with Groove Fittings and with suitable Insulation as per Technical specification.

GI pipes (Class B) for drain pipe with suitable insulation for chilled water system

Only Floor Mounted Air Handling Units (Non-certified) to Convey Chilled Air.

All AC Ducting System shall be Factory Pre Cut coated Pre-insulated (no-oxidation) PIR Panels GreenPro Certified, HCFC & CFC Free.

Small Class/Lecture room, offices, faculty room, conference room & meeting room shall have VAV boxes with thermostat for individual control (As per GFC Drawings).

Chilled Water flow Modulation by means of Manual Butterfly, PICV, Y-strainer, Temperature Gauge, Pressure Gauge, Valve with insulation. All the valves must be minimum PN16 rated and suitable for Chilled Water and Hot Water applications. Insulation of valves shall be the same as that of pipe.

PICV shall be provided at AHU out let. The contractor shall provide the schedule of the basis of the selection PICV according to the equipment tag number.

Air Flow Modulation by means of Air Distribution devices like Volume Control Duct Dampers, Collar Dampers, CAV/VAV Boxes conforming to ASME and SMACNA Standards.

The scheme of colour code painting of pipe work services for AC installation shall be as per NBC/ CPWD specifications.

Provision of trap door of suitable material & size shall be considered for easy accessibility of moving parts of the concerned equipment/dampers.

BMS Compatibility to all Air Conditioning (3 phase equipment) High Side and Low Side Equipment.

Heat recovery units (Plate Heat Exchanger Type) shall be provided.

RAL Colour of Grill, Diffuser, Cassette Unit, Louvers, any exposed item which is coming in the habitable spaces should be selected after confirmation from interior designer.

All AHUs shall have coil mounted UVGI.
Lab Ventilation.

Toilet Ventilation.

Heating System

No Comfort heating proposed.

Guest House Building

VRF/VRV System (Both heating as well as cooling mode) being considered for Guest House Building.

Guest Rooms, Entrance Lobby & Dining Areas will be Air-conditioned however Guest corridor Non-AC.

Kitchen ventilation shall be done by dry scrubber (Exhaust) & air washer (supply).

No fresh air is supplied in guest room, it will be accomplish by infiltration due negative pressure created by toilet exhaust fan.

Kitchen ventilation shall be done by dry scrubber (Exhaust) & air washer (supply).

Guest room toilet shall be ventilated by cabinet fan placed at terrace and connected through duct.

PARTICULAR TECHNICAL SPECIFICATIONS

PARTICULAR SPECIFICATIONS- HVAC WORKS

A. GENERAL

Scope of work shall include supply, installation, testing & commissioning of HVAC system. All material shall be of conforming to relevant IS specifications wherever exists and subject to approval of Engineer-In-Charge. The HVAC system shall be carried out strictly as per NBC - 2016/ASHRAE/ISHRAE/CPWD/ECBC latest versions.

1. TENDER GOOD FOR CONSTRUCTION (GFC) DRAWINGS

GFC drawings (Schematic, HVAC Layout/External Burried Pipe layout, Plant Room Layout etc.) are enclosed with these tender documents. The contractor on award of work will furnish detailed shop drawings and get approval from Engineer- In-charge before start the work.

2. SHOP DRAWINGS/ TECHNICAL DATA SHEETS

The contractor shall prepare and furnish all shop drawings including floor plans & Terrace, Schematic HVAC Layout/External HVAC pipe routing etc.

The manufacturing of equipment shall be commenced only after the shop drawings/GA Drawings/ technical data sheet along with pump curves are approved in writing by the Engineer-In-Charge. Such drawings shall be co-ordinated with other services work. These shop drawings will be approved by AAHII which will be considered as base for execution of work.

3. COMPLETION / AS BUILT DRAWINGS

On completion of the work and before issuance of certificate of virtual completion, the contractor shall submit to the Engineer –in-Charge, General layout drawings, drawn at approved scale indicating layout of pump house piping and its accessories -As installed. AS built drawings shall be prepared taking approved shop drawings as base & incorporating all changes/ modifications as per site conditions. These drawings shall include the following:-

- a. General Layout of Plant Room including all details mentioned in clause 1.2
- b. Panels and other equipment/accessories location and their dimensions etc.
- c. HVAC floor layout including terrace Plan etc.
- d. Complete schematic as installed.
- e. Route of all cables and pipes run along with detail sizes and mode of installation.

4. DRAWINGS & DOCUMENTS

The contractor shall submit to the Engineer-In-Charge, the following documents on completion of the work and before issuance of virtual completion.

- a. Warranty for required equipment installed like Pumps, Panels, Chillers, Cooling Tower, HWG, AHU, FCU etc.
- b. As Built Drawings
- c. Material Test Certificates
- d. Catalogues/Brochures
- e. Operation and Maintenance Manuals
- f. List of recommended spares and consumables
- g. All approvals including technical approvals and sanctions

- h. NOC from Fire authority before commencement of execution & after completion of entire work etc.

5. MANUFACTURING

The responsibility for ensuring the manufacture of the equipment as per the specifications shall be solely that of the contractor. The contractor shall be responsible for selection of materials as per agreed specifications.

6. MAKE OF MATERIALS/MANUFACTURER'S INSTRUCTION

Only approved makes as mentioned in our approved make list of tender documents of material shall be used. The Contractor shall furnish Technical data sheets / GA drawings of all items before placing P.O. The contractor shall get the samples of required items approved from the AAHII as conveyed by E-I-C before commencing the supply. In case of any discrepancy/anomalies wrt specifications, prior intimation from Contractor to E-I-C to be given. Final decision lies with AAHII for according approvals.

Any specific instruction furnished by manufacturer covering the points not mentioned in technical specifications of the tender shall be brought to the notice of E-I-C in writing for further instructions in this regard at appropriate time.

7. MATERIAL TESTING

The E-I-C shall have full power to get any material of work to be tested by an independent agency at contractor's expense in order to prove the soundness and adequacy.

8. INSPECTION AND TESTING

- a. All equipment shall be inspected and tested as per an agreed Quality Assurance Plan before the same is packed and dispatched from the contractor's works. The contractor shall carry out tests as specified/ directed by Engineer-In-Charge.
- b. The E-I-C may, at his sole discretion, carry out inspection at different stages during manufacturing and final testing after manufacturing.
- c. Approvals or passing of any inspection by the Engineer-In-Charge or his authorized representative shall not, however, prejudice the right of the Engineer-In-Charge to reject the plan if it does not comply with the specification when erected or give complete satisfaction in service.

9. TRAINING OF DEPARTMENT PERSONNEL

- a. The contractor shall train the AAHII's personnel to become proficient in operating the equipment installed. Training shall be done before the expiry of the defects liability period (Two year after completion & handing over).
- b. The period of training shall be adequate and mutually agreed upon by the Engineer-In-Charge and contractor.
- c. The AAHII's personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing, minor repairs and replacement.
- d. Nothing extra shall be paid to the contractor for training AAHII's personnel.

10. PERFORMANCE GUARANTEE

At the close of the work and before issue of final certificate of virtual completion by the Engineer- In-Charge, the contractor shall furnish written guarantee indemnifying the AAHII against defective materials and workmanship for a period of two year after completion and handing over. The contractor shall hold himself fully responsible for reinstallation or replace free of cost to the AAHII.

- a. Any defective material or equipment supplied by the contractor.
- b. Any material or equipment supplied by the AAHII which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

11. OPERATION & MAINTENANCE by contractor for a period of 6 months

At the close of the work and after the issue of final certificate, the contractor will operate & mention (the complete HVAC system including BMS system for a period of six month). During the period the contractor will also train the AAHII technical operational staffs.

Note: - Both centrifugal and screw chillers shall be of same make for ease of maintenance.

B. DESIGN PARAMETERS

1. Basis of Design

General

Site location. : Guwahati (**Assam**)
 Latitude. : 26.106°N
 Longitude : 91.586° E
 Altitude. : 49 meters above mean sea level

2. Outside Conditions

Outdoor Design Conditions for Guwahati are based on Weather data (As per ASHRAE Handbook – Fundamentals-2021):-

Summer:	35.2 Deg C DB	27.8 Deg C WB
	95.36 Deg F DB	82.04 Deg F WB
Monsoon:	33.3 Deg C DB	29.5 Deg C WB
	91.94 Deg F DB	85.1 Deg F WB
Winter:	11.0 Deg C DB	
	51.8 Deg F DB	

3. Inside Conditions.
As per ASHRAE & NABH standard. (For Hospital)

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
Negative Isolation	Negative	2	12	Yes	No	MERV-14	55 ± 5	23 ± 1
Positive Isolation	Positive	2	12	NR	No	MERV-16	55 ± 5	23 ± 1
Medical Store	Positive	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Laundry	Negative	2	10	Yes	NO	MERV-8	55 ± 5	23 ± 1
Dialysis Pod	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Dialyzer	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Dialysate	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Day Care	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1
GI Endoscopy	NR	2	6	NR	NO	MERV-8	55 ± 5	23 ± 1
Capsule Endoscopy	NR	2	6	NR	NO	MERV-8	55 ± 5	23 ± 1
Med, Pulmo & Dentistry OPD	NR	2	2	NR	NO	MERV-8	55 ± 5	23 ± 1
Screening OPD	NR	2	2	NR	NO	MERV-8	55 ± 5	23 ± 1
Consultant Room	NR	2	4	NR	NO	MERV-8	55 ± 5	23 ± 1
OPG	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
CBCT	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Examination Room	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
Treatment Room	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
MRI	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Mammography	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Waiting VIP Clinic	NR	2	2	NR	NO	MERV-8	55 ± 5	23 ± 1
PAC Room	NR	2	4	NR	NO	MERV-8	55 ± 5	23 ± 1
Donor's Room	NR	2	4	NR	NO	MERV-8	55 ± 5	23 ± 1
Auto-Clave	NR	2	4	NR	NO	MERV-8	55 ± 5	23 ± 1
Transmission Transfusion Infection (TTI)	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Hematology	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Apheresis	NR	2	6	NR	NO	MERV-8	55 ± 5	23 ± 1
Waiting (Radiology)	Negative	2	12	Yes	NR	MERV-8	55 ± 5	23 ± 1
Counselling Room	NR	2	4	NR	NO	MERV-8	55 ± 5	23 ± 1
Blood Storage	NR	2	4	NR	NO	MERV-8	55 ± 5	23 ± 1
Blood Issue	NR	2	4	NR	NO	MERV-8	55 ± 5	23 ± 1
Component lab	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Pharmacy	Positive	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Sample Collect	Positive	2	4	NR	NO	MERV-8	55 ± 5	23 ± 1
CT Scan	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Minor Treatment Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Nurse Duty Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
Doc Duty Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
X-Ray	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Dexa	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Observation Bed	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Cadaver Store	Negative	2	10	Yes	NO	MERV-8	55 ± 5	23 ± 1
Intensive Care-Red	Negative	2	12	Yes	NR	MERV-8	55 ± 5	23 ± 1
Triage	Negative	2	12	Yes	NR	MERV-8	55 ± 5	23 ± 1
CCU	NR	2	6	NR	NO	MERV-14	55 ± 5	23 ± 1
ICU	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1
Cath Lab	Positive	4	20	NR	No	MERV-16	55 ± 5	22 ± 1
Pre Cath Area	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1
Side Lab	Negative	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Medication Room	NR	2	4	NR	NR	MERV-14	55 ± 5	23 ± 1
Ante at Isolation	NR	2	10	NR	NO	MERV-14	55 ± 5	23 ± 1
ECG	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Procedure Room	Positive	3	15	NR	NO	MERV-14	55 ± 5	23 ± 1
Doppler	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Echo/Holter	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Stress Test	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
CSSD (Dirt Zone Assume)	Negative	2	10	Yes	NO	MERV-8	55 ± 5	23 ± 1
CSSD (Clean Zone)	Positive	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
CSSD Store	Positive	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Linen Store	Positive	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
Bio Medical Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Anesthetist Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
TSSU	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Pre OP	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1
Post OP	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1
Sterile Store	Positive	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Sample Receiving Area/ Processing Area	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Flow Cytometry	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Histopathology	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Automated Microbiology/ Bacteriology	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Clinical Pathology	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Automated Manual Serology	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Core Lab	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Negative Pressure Bacteriology Room	Negative	2	4	Yes	NO	MERV-8	55 ± 5	23 ± 1
Negative Pressure Viral Culture	Negative	2	4	Yes	NO	MERV-8	55 ± 5	23 ± 1
Negative Pressure Fungal Culture	Negative	2	4	Yes	NO	MERV-8	55 ± 5	23 ± 1
TB Room	Negative	2	12	Yes	NO	MERV-14	55 ± 5	23 ± 1
Airlock	Positive	2	4	Yes	NO	MERV-8	55 ± 5	23 ± 1
Milk Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Mother's Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
NICU	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
Preparation Room	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Labor Room	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
LDR	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Patient 6 Bedded Ward	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1
Recovery	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1
Patient Single/double Bedded Ward	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1
HDU	NR	2	6	NR	NR	MERV-14	55 ± 5	23 ± 1
Uroflowmetry	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Urodynamics	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
CU	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Cryo Unit	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Bera	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Flow Cytometry (Therapy Cell)	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Reagent Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Sample Prep.	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Post PCR NGS/ Sanger clean up	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
NGS	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Reagent Prep.	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Target Prep.	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Post PCR	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Sterile Instrumentation Facility	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Immunology Lab	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
Instrumentation Facility	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Sterilization Facility	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Sanger Sequencing	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
PCR/RT-PCR	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Cell Culture/ Organogenesis Facility	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Gait Lab	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Robotic Lab	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Molecular Omics Facility	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Sterilization Room	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Medical Devices Diagnostic lab	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Neurology Diagnosis & Therapy lab	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
OT'S	Positive	4	20	NR	NO	MERV-16	55 ± 5	21 ± 1
OT (2 nos.)	Positive	4	20	Yes	NO	MERV-16	55 ± 5	18 ± 1
Sterile Corridor	Positive	2	2	NR	NO	MERV-14	55 ± 5	23 ± 1
Other Support Areas								
Main LV Room/LV Rm.	NR	0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Equipment Store	NR	5cfm/person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
General Store	NR	5cfm/person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Corridor Area	NR	0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
Reading Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Waiting/Reception Area	NR	5cfm/ person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
CH./Locker Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Lobby/Atrium	NR	5cfm/ person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Lift Lobby	NR	5cfm/ person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Control Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Equipment Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
UPS/Battery Rm.	NR	2	2	NR	NR	MERV-8	55 ± 5	23 ± 1
IT Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Integration Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Lounge	NR	7.5 cfm/ person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Fluid Store	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
OT Document	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Orderly Lounge	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Offices/Meeting/Conference	NR	5 cfm/ person+ 0.06/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Collaboration Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
HOD	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Data Centre	NR	10 cfm/ person+ 0.12/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
Gym	NR	0.3/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Seminar Hall	NR	5 cfm/person+ 0.06/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Pre Function	NR	7.5 cfm/person+ 0.06/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Services	NR	5 cfm/person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Pass Box	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Rooms	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Ante at Room	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Medical Record	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Pneumatic Plant	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Engineering Section	NR	5 cfm/person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Workstation	NR	5 cfm/person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Data Centre Super Computer Room	NR	10 cfm/person+ 0.12/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1

Note:-As per above table

1. For areas where required filtration level MERV-8/MERV-14 shall have electrostatic participation technology (ESP) filter with MERV-14 filtration level placed inside AHU.

2. For areas where required filtration level MERV-16 shall have electrostatic participation technology (ESP) filter with MERV-14 filtration level placed inside AHU and HEPA filter placed at terminal/inside AHU as per requirement.

3.2 Inside Conditions. (For R&D Block)

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
R&D BLOCK								
Entrance Lobby	NR	5 cfm/person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Lift Lobby	NR	5cfm/person+ 0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Corridor Area	Non-AC							
UPS Room	NR	0.06/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Fire Command Rm.	NR	5cfm/person+ 0.06/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Faculty Room at Labs	NR	2	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Cafeteria	NR	7.5cfm/person+ 0.18/Ft ²	2	NR	NR	MERV-8	55 ± 5	23 ± 1
Pre Function Area	NR	7.5 cfm/person+ 0.06/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Store	NR	5 cfm/person+ 0.06/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Office/Board Rm./HOD Rm.	NR	5 cfm/person+ 0.06/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Lecture Hall	NR	7.5 cfm/person+ 0.06/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Class Room	NR	7.5 cfm/person+ 0.06/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1

Function of Space (ee)	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Minimum Filter Efficiencies (cc)	Design Relative Humidity (k), %	Design Temperature (I), °F/°C
Library	NR	5 cfm/person+ 0.12/Ft ²	4	NR	NR	MERV-8	55 ± 5	23 ± 1
Microscopy Lab	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Electrical & Electronic Characterization Lab	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Mechanical Characterization lab	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Material Characterization lab	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Advance Electronics lab	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Testing lab	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Incubator Bionest	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Computational Lab	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Design Lab	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1
Simulation Lab with AR/VR	NR	2	6	NR	NR	MERV-8	55 ± 5	23 ± 1
Open Lab	Negative	2	6	Yes	NO	MERV-8	55 ± 5	23 ± 1

Note:-As

per

above

table

3. For areas where required filtration level MERV-8/MERV-14 shall have electrostatic participation technology (ESP) filter with MERV-14 filtration level placed inside AHU.
4. For areas where required filtration level MERV-16 shall have electrostatic participation technology (ESP) filter with MERV-14 filtration level placed inside AHU and HEPA filter placed at terminal/inside AHU as per requirement.

.3 Inside Conditions. (For Guest House)

Function of Space	Out Door Air	Minimum Filter Efficiencies	Design Relative Humidity, %	Design Temperature °C
Guest House				
Guest House	50cfm/room	MERV-8	55 ± 5	24 ± 1
Entrance Lobby	5cfm/ person+ 0.06/Ft ²	MERV-8	55 ± 5	24 ± 1
Entrance Lobby	7.5cfm/ person+ 0.18/Ft ²	MERV-8	55 ± 5	24 ± 1
Corridor Area	Non-AC			

4. MECHANICAL VENTILATION: (Air Changes per Hour)

S. No.	Description	Air Changes per Hour
1	Toilet (Public)	As per NBC 10 ACPH or per WC/IWC cubicle min 70 CFM (Whichever is higher)
2	Stores	6 ACPH
3	AC Plant/Other Plant Rooms/ LT/HT Panel Room/MGPS	12 ACPH
5	STP	30 ACPH Exhaust & 27 ACPH Supply
4	Kitchen	40 ACPH assumed for exhaust air scrubber sizing & fans Air Washer capacity @85% of Exhaust capacity
5	Laundry	40 ACPH assumed for exhaust air scrubber sizing & fans Air Washer capacity @85% of Exhaust capacity
6	Bio Medical Waste	25 ACPH
7	Smoke Exhaust for any Public area and corridor above basement (for Hospital block only)	12 ACPH Exhaust & 12 ACPH Make up air
8	Lift well pressurization (for Hospital block only)	Mechanically pressurized for maintaining 50 Pa
9	Lift lobby pressurization (for Hospital block only)	Mechanical pressurized for maintaining 25 to 30Pa.
10	Staircase pressurization (for Hospital block only)	Mechanically pressurized for maintaining 50 Pa
11	No mechanical pressurization proposed in R&D, Guest House & Residential Block	

5. Air Conditioning System:

- i. Centralized Chilled Water Air Conditioning System being considered for Hospital and R & D Center Blocks. Hot Water Generators will be used for monsoon reheat of critical areas like areas (such as OT, Cath-Lab, ICU, CCU, PICU, Pre-operation, Post-operation, radiology, labs & NICU) etc. All critical areas will have 4 pipe system (separate cooling & heating pipe network) & balance area's AHU will be with 2 pipe system (to provide cooling as well as comfort heating by using switch over mode through hot water generator for hospital only). For R&D Center only cooling to be considered
- ii. For OTs & cath lab & sterile corridor separate chiller to be provided.
- iii. Two OTs shall be design for $18 \pm 1^{\circ}$ C with RH 50% to 60%, at 100% fresh air. To achieve 18° C temperature AHU shall have enthalpy wheel, Descent wheel, chilled water cooling coil, re-heat coil, DX cooling coil connected to dedicate DX out door unit.
- iv. Rest all OTs & Cath Lab shall be design for $21 \pm 1^{\circ}$ C with RH 50% to 60% with re-circulatory system.
- v. OT with re-circulatory system shall have flushing/purging system.
- vi. Variable Refrigerant Volume/Flow System for Guest House is being considered.

- vii. Precession AC shall be considered for Server Rooms etc with N+1 configuration.
- viii. UPS room shall have DX split system.
- ix. All the equipments etc. shall be suitable for 415 V, three phases or 220 V, Single phase, 50 Hz A.C. supply.
- x. For re-heat system hot water generator and variable hot water pumps shall be placed in plant room as per requirement.
- xi. All Primary Variable Chilled Water Pumps will be with unit mounted Variable Speed Drives circulating water in the chilled/hot water circuit.
- xii. Provision of specialized equipment like Air and Dirt Separator in the Plant Room to ensure smoother operation, enhanced efficiency of system and longevity.
- xiii. Chilled Water Circuit comprising of MS pipes ("C" Class) with suitable Insulation in case of Centralized Chilled Water System.
- xiv. GI pipes (Class B) for drain pipe with suitable insulation for chilled water system
- xv. u-PVC Pipe for drain with suitable insulation for VRF/VRV system.
- xvi. Only Floor Mounted Air Handling Units, child water cassette, Fan Coil Units to Convey Chilled Air in case of Chilled Water System and Ductable/ Cassette / Hi Wall Split Units in case of VRV/VRF System.
- xvii. Pressurized Expansion Tank to adjust and regulate the pressure of water in the Chilled and Hot Water Circuit shall be provided.
- xviii. All AC Ducting System shall be Factory Pre Cut coated Pre-insulated (no-oxidation) PIR Panels GreenPro Certified, HCFC & CFC Free. Ducted supply and return both to be considered for all ac areas in Hospital, R & D Centre & Guest House. Supply & return duct shall be as per GFC drawings.
- xix. Ventilation Ducting System comprising of GI Ducting. Duct Construction and suspension Standards must conform to IS 655.
- xx. All smoke exhaust duct shall be quoted by fire paint (2hr @ 250°C).
- xxi. CTI certified Cooling Tower with VFD driven Fan Motors for Chilled Water System.
- xxii. Consultant Room, Waiting areas, class room, offices, conference room & meeting room shall have VAV boxes with thermostat for individual control.
- xxiii. Chilled Water flow Modulation by means of Manual/Motorized Butterfly, Non Return Valve, Ball Valve, Automatic Balancing Valve with insulation. All the valves must be minimum PN16 rated and suitable for Chilled Water and Hot Water applications. Insulation of valves shall be the same as that of pipe.
- xxiv. PIBCVC shall be provided at AHU out let. The contractor shall provide the schedule of the basis of the selection PIBCVC according to the equipment tag number.
- xxv. Air Flow Modulation by means of Air Distribution devices like Volume Control Duct Dampers, Collar Dampers, CAV/VAV Boxes conforming to ASME Standards.
- xxvi. Colour scheme for equipment like Chillers/Pumps/AHUs/Cooling Tower etc. shall be as per manufacturer's standard color scheme or as per directions of E-I-C.
- xxvii. The scheme of colour code painting of pipe work services for AC installation shall be as per NBC/CPWD specifications.

- xxviii. Provision of trap door of suitable material & size shall be considered for easy accessibility of moving parts of the concerned equipment/dampers.
- xxix. BMS Compatibility to all Air Conditioning (3 phase equipment) High Side and Low Side Equipment.
- xxx. Touch screen types central controller to be provide for guest house with provision to ingrate the same on BMS.
- xxxi. Heat recovery units (Plate Heat Exchanger Type) shall be provided.
- xxxii. Automatic controlled Tube cleaning system to be provided.
- xxxiii. RAL Colour of Grill, Diffuser, Cassette Unit, Louvers, any exposed item which is coming in the habitable spaces should be selected after confirmation from interior designer.
- xxxiv. All OTs & Cath Lab AHUs shall have ultra-sonic humidifier.
- xxxv. All AHUs shall have coil mounted UVGI.
- xxxvi. Duct mounted UVGI to be considered for all critical areas (such as OT, Cath-Lab, ICU, CCU, PICU, Pre-operation, Post-operation, radiology, labs & NICU).
- xxxvii. The P.E Isolation rooms have individual AHU with HEPA filters at terminal.
- xxxviii. For A.I.I. Isolation rooms to be considered a once through air circulation philosophy (all air exhausted at terrace level with HEPA filter with 1W+1S exhaust fan) with the supply air being fed by the ICU/Ward AHU, no return air is being taken from these rooms.

6. Design Consideration:

Duct shall be sized for the following design parameters:

AC supply Duct velocity: Max 1500 FPM

AC supply Duct velocity: Max friction 0.1 in/100 ft

AC supply Duct velocity: Max 1300 FPM

Ventilation Supply/Exhaust Duct velocity (Normal ventilation): Max 1800 FPM

Ventilation Supply/Exhaust Duct velocity (Emergency ventilation): Max 3000 FPM

Piping shall be sized for the following design parameters:

Nominal Pipe Size, in.	Flow in (GPM)	
	Other (For Condenser Line) >4400 and ≤ 8760 Hours/Year	Variable Flow/ Variable Speed (For Chilled Water Line) >4400 and ≤ 8760 Hours/Year
2 1/2	68	110
3	110	170
4	210	320
5	250	370
6	440	680
8	510	770
10	1000	1600
12	1500	2300

Maximum Velocity for Pipes over 12 in. Size	5.0 fps	7.5 fps
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7. Control for AHU with reheat & Cooling Coil.

The AHU with chilled water coil temperature control & Hot water coil for RH coil. The room/return path shall have Temperature & RH controller in the room in which the temperature parameters and RH parameters settings can be done.

The AHU shall have independent PICV at the return of each coil. PICV specifications shall be followed as given under PICV section.

The temperature and RH controller shall give the command to PICV as per the room condition requirements for Temperature & RH.

8. For AHU's VFD

AHU's for general area's with variable load - All AHU's catering variable air/cooling requirement should have Variable Speed Drives with build in Active Harmonic Filter to reduce harmonics also THDi shall be less than 5% at equipment level without any external active/ passive harmonic filter and IP-55 Protection, VFD must have voltage boost feature & power factory unity so that less amount of power required which reduces losses, the VFD outer material shall not be made in plastic. The AHU VFD shall have minimum 3 analogue inputs for feedback and should have feature to display AHU motor power consumption, so that system curve can be optimized at site as per system requirement. The VFD's should modulate AHU's fan speed based on the analogue input from Temperature sensors at various Zones/Area's to achieve continues energy savings based on occupancy and temperature requirement fluctuations. VFD must communicate with BMS on BacNet communication for faster data transmission

AHU's connected to VAV Boxes (Variable Air Volume Boxes)- All AHU's connected to Variable Air Volume Boxes to cater different requirement of air/cooling in different zones/area's should have Variable Speed Drives with build in Active Harmonic Filter to reduce harmonics also THDi shall be less than 5% at equipment level without any external active/passive harmonic filter and IP-55 Protection, VFD must have voltage boost feature & power factory unity so that less amount of power required which reduces losses, the VFD outer material shall not be made in plastic. The AHU VFD shall have minimum 3 analogue inputs for feedback and should have feature to display AHU motor power consumption, so that system curve can be optimized at site as per system requirement. The VFD's should modulate AHU's fan speed based on the analogue input from pressure sensors (DP's) at various Zones/Area's to achieve continues energy savings based on occupancy and temperature requirements at different zones/area's. VFD must communicate with BMS on BacNet communication for faster data transmission

AHU's for Critical area's/Fixed Cooling Load- All AHU's connected to Critical area's /Fixed cooling Load to cater constant air/temp in critical area's should have VFD's to synchronise RPM and Frequencies of fan and motor as all fans are direct driven hence VFD's will be required to synchronise the fan and motor. The Variable Speed Drives should be with build in Active Harmonic Filter to reduce harmonics also THDi shall be less than 5% at equipment level without any external active/passive harmonic filter and IP-55 Protection, VFD must have voltage boost feature & power factory unity so that less amount of power required which reduces losses, the VFD outer material shall not be made in plastic. The VFD's should capable to re-sync after any maintenance /repair or other routine activity. VFD must communicate with BMS on BacNet communication for faster data transmission

9. VAV Boxes

Variable Air Volume (VAV) systems enable energy-efficient HVAC system distribution by optimizing the amount and temperature of distributed air. The VAV system helps operation of the AHU at optimum levels delivering power savings.

All ward rooms will have individual VAV box with independent digital thermostat.

VAV Box should be selected based on maximum airflow not more than 2700 CFM ideal operating range should be between 20-100% (minimum airflow 20% to maintain air movement in space)

In spaces where mix of small rooms and large space constant air flow areas are in design , use single duct VAVs upto 2700 CFM and dual duct rectangular VAV boxes capacity 7500-20000 CFM can be used for constant airflow .

Variable Air Volume (VAV) systems enable energy-efficient HVAC system distribution by optimizing the amount and temperature of distributed air. The VAV system helps operation of the AHU at optimum levels delivering power savings.

The controllers used in the VAV terminals shall necessarily be a DDC with 32-bit micro-processor, supporting BACnet MS/TP protocol. The DDC controller shall be a BTL (B-ASC) & CE mark directed.

The VAV thermostats shall be communicating type and have an LCD display that displays the current space temperature. The VAV thermostat shall locally have the feature of locking all keys & enabling essential keys as and when required. Option of providing analogue VAV thermostats to be available (where the VAV thermostats are located remote).

The VAV terminals shall have the capability of interfacing with the BMS. Through this interface it shall be possible to perform monitoring, control and programming functions from the BMS. Failure of the communications network.

BMS System- All E & M services and low and high side of the AC plant shall be monitored &/or controlled with recording, display, analysis, hardware and software for optimization of electrical load and energy conservation, and all parameters of all other E&M Equipments, Services, Utilities etc.,

Pressurization of Stair case, Lift shafts and lobbies with pressurization fans, ducting, Control Panels, cabling, Smoke Evacuation and mechanical ventilation System on all floors. Kitchen ventilation, Toilet Exhaust System. PAC for Server rooms.

10. CHILLER PLANT OPTIMIZER

WATER COOLED CHILLER PLANT CONTROL SYSTEM DESCRIPTION

This specification applies to the automation of a Water-Cooled Chiller Plant, which has 5 Water-cooled Chillers in parallel, 5 header cooling towers in parallel, 6 headed condenser pumps, 6 headed and primary variable pumps

The plant control system shall be supplied with all the hardware, software and programming required to control up to 5 water cooled chillers, up to 5 cooling towers fans variable speed drives, up to 5 cooling tower isolation valves, up to 6 condenser pumps, up to 6 primary variable distribution pumps, up to 5 chiller isolation.

A. The quantity of chillers, pumps, valves and demand sensors to be controlled shall be independently configurable on-site at the graphic user interface by selection from pull down menus, without requiring reprogramming or software download. All schematics, tables and menus in the graphic user interface shall show only the data and graphics corresponding to the selected configuration.

B. Only the field sensors (temperature, flow, differential pressure, etc.) shall be supplied in the quantities required by the configuration in paragraph A, except as indicated in the Spares section.

C. The plant control system shall be supplied with all the hardware, software and programming required to be seamlessly integrated with the reporting and remote read-write capabilities of the building automation system (BAS). The control system shall allow field adjustments of control parameters as described below.

D. A remote fault detection and diagnostics service shall be provided including quarterly performance reports and calibration for the first full year following commissioning.

E. Preventative maintenance and service shall be available directly from the manufacturer. This service should include inspection and review of key components, assessment of operation conditions, control system tuning, software upgrades as they are released, back-up and secure storage of parameters and annual training for the Building Operators.

RELATED SECTIONS

F. Section 25 50 00 Integrated Automation Facility Controls

G. Section 23 64 00 – Package Water Chillers

H. Section 23 20 00 - HVAC Piping and Pumps Plumbing Systems

I. Section 23 09 00 – Instrumentation and Control for HVAC

J. Section 23 65 00 – Cooling Towers

STANDARDS REFERENCES AND QUALITY ASSURANCE

The Chilled Water Plant Control System shall be assembled with components that conform to the latest edition of the following as applicable:

1. ANSI – American National Standards Institute
2. NEMA – National Electrical Manufacturers Association
3. UL – Underwriters Laboratories
4. CSA – Canadian Standards Association
5. IEC - Degrees Of Protection Provided By Enclosures (IP Code)
6. ASHRAE 90.1-[2013] - American Society of Heating, Refrigeration and Air-Conditioning Engineers – Energy Efficient Design of New Buildings
7. ASHRAE 100 - American Society of Heating, Refrigeration and Air-Conditioning Engineers – Energy Efficient Design of Existent Buildings
8. The chilled water plant control system manufacturer must hold an ISO 9000 QA certification or approved equal.

Sequence of Operation:

- a. All plant control system settings, including the number of chillers, cooling towers and pumps, as well as how they are connected (headered or dedicated) can be modified at the graphic user interface (GUI) after entering the appropriate password.
- b. The plant control system determines the most efficient combination of operating pumps, and pump operating speed based on the zone differential pressure, zone Temperature sensor signals and/or Parallel Sensorless/Wireless as per the field adjustable configuration.
- c. The control system shall continuously monitor all zone signals to determine an active control zone. Use of a multiplexer for multiple sensor inputs is not acceptable.
- d. The control system shall respond to the most dissatisfied zone by increasing either, the number of operating pumps, or the pump speed.
- e. The control system shall automatically disable any zone differential pressure or Temperature signals that are not within limits and alert the operator of a possible transmitter failure. If system found all differential pressure/temperature sensors failure in the building, the pump speed will default to a pre-defined percent of full speed (factory default loaded as 95% of full speed).
- f. The pump logic control system shall sequence the pumps based on a field adjustable interval of operating hours with a “bump-less” transfer algorithm. The control system incorporates an adjustable PID control loop and embedded logic to prevent hunting.

- g. The control system shall determine the optimum numbers of chillers to operate based on the plant load (thermal energy rejected) or to prevent the flow through the running chillers to exceed their rated maximum (or fall below their minimum), or to exceed the power consumed by the running chillers to exceed their rated maximum, or to prevent the supply temperature to exceed the set point by a field adjustable offset.
 - h. For each chiller the control system has an adjustable field to enter its capacity. The plant load (in Tons and %) is displayed on the touch screen display and used to Stage On and Off the chillers, in conjunction with the other conditions explained in the previous paragraph.
 - i. The control system shall rotate the Lead chiller on a field adjustable interval of operating hours. Should any chiller fail, the control system will trigger an alarm on the touch screen display and remove said chiller from the auto sequence and rotation.
 - j. The control system shall be capable of interfacing with up to 4 isolation valves (used when the chillers are headered). A digital output opens and closes the valves, and a digital input provides open/close feedback.
 - k. The control system modulates the bypass valve to maintain the minimum flow required by the operating chillers.
 - l. The condenser pumps shall maintain the Chiller flow.
 - m. Automatic operation mode: When the chilled plant control system is in automatic operation mode, the chiller plant is automatically start and all equipment is sequenced and modulated entirely automatically to meet the current cooling load with optimum operating efficiency.
 - n. Manual operation mode (for commissioning): When the chilled plant control system is switched to the manual operation mode by the operator, there is no automatic operation or sequencing of any equipment and operation of chillers, chilled water distribution pumps, condenser water pumps, cooling towers and cooling tower fans continue at the same status when operation mode was switched to manual mode, until further changes by the operator. When operation mode is switched back to auto, the automatic operation mode is restarted.
9. The chilled plant control system shall be capable of providing parallel primary pump station control for speed and sequencing of pumps using one or more of the following methods:
- a. Remote zone differential pressure (dP) sensor
 - b. Local pump station dP sensor with simulated quadratic control curve
 - c. Zone return temperature sensor and/or
 - d. Sensorless/Wireless pump speed and Parallel Sensor less/Wireless pump staging.

C. WATER COOLED CENTRIFUGAL CHILLERS

1.0 GENERAL

Each unit will be completely factory-packaged including evaporator, unit mounted VFD starter complete with power/ control cabling etc. by chiller supplier and condenser, sub-cooler, compressor, motor, lubrication system, view control center and all interconnecting unit piping and wiring. Condenser & evaporator water circuits should be even pass design. The chiller will be painted prior to shipment.

Performance will be certified in accordance with ARI Standard 550/590. Only chillers that are listed in the AHRI/ Eurovent Certification Program for Centrifugal are acceptable. Chillers shall be certified at the highest star level (5 star) under BEE. In case no manufacturer is found to received 5 star level certification against their chiller, immediate lower star level shall be considered.

The initial charge of refrigerant and oil will be supplied, shipped in containers and cylinders for field installation or factory charged in the chiller.

Chiller must unload up to 25% at constant lift conditions without surging, environment stability control and hot gas bypass (i.e. at design chilled out water temperature of 44 Deg. F and design condenser entering water temperature + 2 Deg F). AHRI certified computerized sheet mentioning power consumption at part loads at AHRI turndown and constant ECWT (87.39 deg F) of tender conditions must be submitted along with tender for verification from AHRI. Only verified performance sheets will be qualified or approved. BMS card to be provided by chiller vendor. Chiller sound level at 1 mtr distance shall be max 85 d BA as per AHRI 575. Vendor to submit AHRI certified sheets for sound levels. Refrigerant shall be R 134 A/R1233 zd (E) as per ASHRAE A1 safety of classification.

Compressor shall be chiller OEM make only. Third party assembled compressor will not be acceptable.

Variable speed must be used.

BMS Compatible & Bacnet/ Modbus output must be provided for integration with 3rd party BMS

2.0 COMPRESSOR

The compressor will be single / multi-stage centrifugal type in open type / semi-hermetic construction. Driven by electric motors. Compressor shall be designed for 200 psig working pressure and hydrostatically pressure tested at 355 psig for R134a/ R1233 zd (E) units. The rotor assembly will consist of a heat treated alloy steel drive shaft and impeller shaft with cast aluminum, shrouded impeller. The impeller will be designed for balanced thrust, dynamically balanced and over speed tested for smooth, vibration-free operation. The bearing design shall be as per manufacturer/OEM.

Internal single helical gears with crowned teeth will be designed so that more than one tooth is in contact at all times to provide even load distribution and quiet operation. Each gear will be individually mounted in its own journal and thrust bearings to isolate it from impeller and motor forces. Shaft seal if provided shall be provided in double bellows, double-seal, and cartridge type. Auxiliary forced fed oil reservoir will be built into the compressor to provide lubrication during coast down in the event of a power failure. Capacity control will be achieved by use of pre-rotation vanes to provide fully modulating control from maximum to minimum load. The unit will be capable of operating with lower temperature cooling tower water during part-load operation in accordance with ARI Standard 550/590. Pre-rotation vane position will be automatically controlled by an external electric actuator to maintain constant leaving chilled water temperature. Semi- Hermetic motors should be liquid refrigerant cooled with internal thermal overload protection devices embedded of winding in each phase. Chiller should be able to operate till 60 deg F condenser water temperatures. In case chiller is not able to run at 60 deg F or below condenser entry temperatures, manufacturer shall provide head pressure controller to modulate two way butterfly valve in condenser return to cooling tower to ensure chiller operation at start up with 60 deg F condenser water temperature.

3.0 LUBRICATION SYSTEM

Lubrication oil shall be force-fed to all compressor bearings, gears, and rotating surfaces by an external fixed / variable speed oil pump or as per manufacturer compressor design. The oil pump shall vary oil flow to the compressor based on operating and stand-by conditions, ensuring adequate lubrication at all times. The oil pump shall operate prior to start-up, during compressor operation and during coastdown. An emergency lubrication system shall be incorporated in the system to provide lubrication during coast down incase of power failure.

An oil reservoir, separate from the compressor, shall contain the submersible 2 HP oil pump and a suitable capacity oil heater, thermostatically controlled to remove refrigerant from the oil or as Oil reservoir integral to compressor design as per manufacturer / OEM design complying to the functional requirement is also acceptable.

Oil shall be filtered by an externally mounted 10micron replaceable cartridge oil filter equipped with service valves. Oil cooling shall be done via a refrigerant/water cooled oil cooler, with all piping factory installed (No separate arrangement to be done at site). Oil side of the oil cooler shall be provided with service valves. An automatic oil return system to recover any oil that may have migrated to the evaporator shall be provided. Oil piping shall be completely factory installed and tested.

4.0 MOTOR DRIVELINE

The compressor motor shall be 3 Phase squirrel cage induction type as required, protected against damage by means of built in protection devices. The motor shall be rigidly coupled to the compressor to provide factory alignment of motor and compressor shafts.

5.0 EVAPORATOR

Evaporator will be of the shell and tube, flooded type designed for working pressure as per ASME /GB/BIS on the refrigerant side and tested against leaks with a pressure of not less than 1.11times of working pressure. Shell will be fabricated from rolled carbon steel plate with fusion welded seams; have carbon steel tube sheets, drilled and reamed to accommodate the tubes; and intermediate tube supports spaced no more than four feet apart. The refrigerant side will be designed, tested and stamped in accordance with ASME/GB/BIS Pressure Vessel Code. Tubes shall be high-efficiency, internally and externally enhanced type having plain copper lands at all intermediate tube supports to provide maximum tube wall thickness at the support area. Each tube will be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable. Water velocity through the tubes will not exceed 8 fps. The evaporator will have a refrigerant relief device sized to meet the requirements of ASHRAE 15 Safety Code for Mechanical Refrigeration. The chiller shall be insulated with 25 mm thick factory installed elastomeric insulation with vapour barrier. The insulation shall be applied in such a manner that water boxes and covers can be removed without damaging it. Pressure drop on water side shall not exceed, 10m (ten meters) WC. Water boxes and cover plates will be removable type to permit tube cleaning and replacement. Stub out water connections having flanged connections will be provided. Vent and drain connections with plugs will be provided on each water box.

6.0 CONDENSER

Condenser will be of the shell and tube type, designed working pressure as per ASME /GB/BIS on the refrigerant side and tested against leaks with a pressure of not less than 1.11times of working pressure. Shell will be fabricated from rolled carbon steel plate with fusion welded seams; have carbon steel tube sheets, drilled and reamed to accommodate the tubes; and intermediate tube supports spaced no more than four feet apart. The refrigerant side will be designed, tested and stamped in accordance with ASME or GB/BIS Pressure Vessel Code, Tubes shall be high-efficiency, internally and externally enhanced type having plain copper lands at all intermediate tube supports to provide maximum tube wall thickness at the support area. Each tube will be roller expanded into the tube sheets providing a leak proof seal, and be individually replaceable. Water velocity through the tubes will not exceed 8 fps. Pressure drop shall not exceed 10m (Ten metres) water boxes and cover plates will be removable to permit tube cleaning and replacement. Stubout water connections having flanged connections will be provided. Vent and drain connections with plugs will be provided on each water box.

7.0 REFRIGERANT FLOW CONTROL

Refrigerant flow to the evaporator will be controlled by a variable orifice/ fixed orifice with modulating valve / thermostatic expansion valve for improving unloading capabilities as per the manufacturer standard complying to functional requirement and unloading percentage required in the specifications.

COMPRESSOR MOTOR STARTER

The starter will be variable speed drive type and will be factory installed and unit mounted only. VFD shall be liquid/refrigerant/Air cooled. It will vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. It will also have inbuilt circuit breaker too isolate electrical supply. The adaptive capacity control logic shall automatically adjust motor speed and compressor pre-rotation vane position independently for maximum part-load efficiency by analyzing information fed to it by sensors located throughout the chiller.

Drive will be utilizing IGBT's with a power factor of 0.95 or better at full load and speeds.

The variable speed drive will be unit mounted/floor standing with NEMA-1/IP-22 enclosure with all power and control wiring between the drive and chiller, including power to the chiller oil pump. VFD must be supplied with active harmonic filters (Floor/Unit Mounted) with THDI and TDD less than 5% at chiller source itself. Both voltage and current harmonics must be displayed in main chiller control panel/AHF panel.

In case of free standing VFD complete scope of interconnecting cable works, conduit works, cable stand shall be in the scope of chiller vendor.

The following features will be provided:

- Door interlocked circuit breaker capable of being padlocked.
- Ground fault protection.
- Over voltage and under voltage protection.
- 3-phase sensing motor over current protection.
- Single phase protection.
- Insensitive to phase rotation.
- Over temperature protection.
- Digital readout at the chiller unit control panel of output frequency, output voltage, 3-phase output current, input kilowatts and kilowatt-hours, self-diagnostic service parameters.

KW Meter - The unit's input power consumption will be measured and displayed digitally via the unit's control panel.

KWh Meter - The unit's cumulative input power consumption is measured and displayed digitally via the unit's control panel.

Ammeter - Simultaneous three-phase true RMS digital readout via the unit control panel. Three current transformers provide isolated sensing. The ammeter accuracy is typically +/- 3% of reading.

Voltmeter - Simultaneous three-phase true RMS digital readout via the unit control panel. The voltmeter accuracy is typically +/- 3% of reading.

Elapsed Time Meter - Digital readout of the unit's elapsed running time is displayed via the unit control panel.

8.0 GRAPHIC CONTROL CENTER

The chiller shall be controlled by a unit mounted microprocessor based control center. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches.

The control panel shall have touch screen control. The screen shall detail all operations and parameters, using a graphical representation of the chiller and its major components. Panel verbiage shall be available in other languages as an option with English always available. Data shall be displayed in either English or Metric units.

The sophisticated program and sensor shall monitor the chiller water temperature to prevent freeze up. When needed hot gas bypass is available as an option. The panel shall display countdown timer messages so the operator knows when functions are starting and stopping. Every programmable point shall have a pop-up screen with the allowable ranges, so that the chiller cannot be programmed to operate outside of its design limits.

The chiller control panel shall also provide:

1. System operating information including:
 - a. return and leaving chilled water temperature
 - b. return and leaving condenser water temperature
 - c. evaporator and condenser saturation temperature
 - d. differential oil pressure
 - e. percent motor current
 - f. evaporator and condenser saturation temperature
 - g. compressor discharge temperature
 - h. oil reservoir temperature
 - i. oil temperature
 - j. operating hours
 - k. number of compressor starts
2. Digital programming of setpoints through the universal keypad including:
 - a. leaving chilled water temperature
 - b. percent current limit
 - c. pull-down demand limiting
 - d. schedule for starting and stopping the chiller, pumps and tower
 - e. remote reset temperature range
3. Status messages indicating:
 - a. system ready to start
 - b. system running
 - c. system shutdown
 - d. system safety shutdown-manual restart
 - e. system cycling shutdown-auto restart
 - f. system prelube
 - g. start inhibit
4. The text displayed within the system status and system details field shall be displayed as a color coded message to indicate severity.
5. Safety shutdowns enunciated through the display and the status bar, and consist of system status, system details, day, time, cause of shutdown, and type of restart required. Safety shutdowns with a fixed speed drive shall include:
 - a. evaporator – low pressure
 - b. evaporator – transducer or leaving liquid probe
 - c. evaporator – transducer or temperature sensor
 - d. condenser – high pressure contacts open
 - e. condenser – high pressure
 - f. condenser – pressure transducer out of range
 - g. auxiliary safety – contacts closed
 - h. discharge – high temperature
 - i. oil – high temperature
 - j. oil – low differential pressure
 - k. oil – sump pressure transducer out of range
 - l. oil – variable speed pump – pressure setpoint not achieved (if applicable)
 - m. control panel – power failure
 - n. motor or starter – current imbalance
 - o. thrust bearing – high oil temperature
 - p. thrust bearing – oil temperature sensor
 - q. software reboot

5.1 Safety shutdowns with a VFD Shall include:

- a. VFD shutdown – requesting fault data
 - b. VFD – stop contacts open
 - c. VFD – 110% motor current overload
 - d. VFD – high phase A, B,C inverter heatsink temp.
 - e. VFD – high converter heatsink temperature
6. Cycling shutdowns enunciated through the display and the status bar, and consists of system status, system details, day, time, cause of shutdown, and type of restart required. Cycling shutdowns with a fixed speed drive shall include:
- a. multiunit cycling – contacts open
 - b. system cycling - contacts open
 - c. oil - low temperature differential
 - d. oil – low temperature
 - e. control panel - power failure
 - f. leaving chilled liquid - low temperature
 - g. leaving chilled liquid - flow switch open
 - h. motor controller – contacts open
 - i. motor controller – loss of current
 - j. power fault
 - k. control panel - schedule
 - l. starter – low supply line voltage
 - m. starter – low supply line voltage
 - n. proximity probe – low supply voltage
 - o. oil - variable speed pump - drive contacts open (if applicable)
- 6.1 Cycling shutdowns with a VFD shall include all necessary parameters.
7. Security access to prevent unauthorized change of set points, to allow local or remote control of the chiller, and to allow manual operation of the prerotation vanes and oil pump. Access shall be through ID and password recognition, which is defined by three different levels of user competence: view, operator, and service.
8. Trending data with the ability to customize points of once every second to once every hour. The panel shall trend different parameters from a list of over 140, without the need of an external monitoring system.
9. The operating program stored in non-volatile memory (EPROM) to eliminate reprogramming the chiller dueto AC power failure or battery discharge. Programmed setpoints shall be retained in lithium battery-backed RTC memory for a minimum of 10 years with power removed from the system.
10. A fused connection through a current transformer in the compressor motor starter to provide individual over- current protected power for all controls.
11. A numbered terminal strip for all required field interlock wiring.
12. An RS-232/RS 485communication port to output all system operating data, shutdown / cycling message, and a record of the last 10 cycling or safety shutdowns to a field-supplied printer. Data logs to a printer at a set programmable interval. This data can be preprogrammed to print for desired time interval.
13. The capability to interface with a building automation system to provide:
- a. remote chiller start and stop
 - b. remote leaving chiller liquid temperature adjust
 - c. remote current limit setpoint adjust
 - d. remote ready to start contacts
 - e. safety shutdown contacts
 - f. cycling shutdown contacts
 - g. run contacts

14 Tests at Factory:

- 14.1 Every chiller shall be tested in accordance with the latest version of IS 16590 with all amendments.
- 14.2 Every chiller shall accompany the manufacturer's energy performance software test reports in the Basic Model Group using the tool/software approved by any national or international accreditation or certification agency. The energy performance software report shall also contain the coefficient of performance values at 25 percent, 50 percent, 75 percent and 100 percent load and Indian Seasonal Energy Efficiency Ratio value as per the test methods and test conditions mentioned in Annex B of IS 16590. In addition to software-based test report, manufacturer is required to also submit the physical test report for parent model under each basic model group in respect of test results of Cooling capacity, Power Consumption and Indian Seasonal Energy Efficiency Ratio in accordance with the test conditions mentioned in IS 16590 with all amendments.
- 14.3 The performance tests shall be conducted in accordance with the standard rating conditions stated in Table no. 1 of clause 6 of IS 16590 with all amendments.
- 14.4 All the measuring instruments shall have accuracy as defined in Table no. 3 of clause 10 of IS 16590 with all amendments. Permissible variation in measurement of each measured quantity shall be in accordance with Table 3 of clause 10 of IS 16950 with all amendments.

15. Tolerance Limits:

- 15.1 The tolerances for Coefficient of Performance (full load and part load), Cooling Capacity (full load and part load) and Indian Seasonal Energy Efficiency Ratio shall be as specified in Table 2 of clause 7.1 of IS 16950 with all amendments provided the Coefficient of Performance declared by the manufacturers does not fall below the value specified in Table 1 and 2 of this order for water cooled and air-cooled condenser respectively.
- 15.2 Full load capacity and full load, part load Coefficient of Performance shall not be less than 100 percent of the rating minus the allowable tolerance calculated using the equation provided in Table 2 of Clause 7.1 of IS 16950 with all amendments.
- 15.3 There shall be no negative tolerance on the performance matrix; Indian Seasonal Energy Efficiency Ratio value specified for each star rating level and all tested equipment shall meet the minimum threshold for each star rating level.
- 15.4 All the values shall be recorded to three significant figures. The Indian Seasonal Energy Efficiency Ratio and Coefficient of Performance value shall be rounded off to two significant figures in accordance with IS 2: 1960 'Rules for rounding off numerical values (with all amendments)'.

16. Test report. –

The results of the chiller sample tested shall be reported on the prescribed format given in Annexure A.

Annexure A
[See paragraph 5]
Form for reporting the results of tests

(Separate test report format shall be used for each type/model)

Test Report No.

Date of Test Report:

1. General Information

Manufacturer/Laboratory name	
Address	
Date of receipt of sample by the test laboratory	
Laboratory Accreditation number	
Validity of the accreditation of the Test laboratory	
Tested by	
Approved by	
Date of testing	

2. Details of samples tested and rated values

Brand name	
Basic Model Group	
Model 1, Model 2, Model 3	
Serial number	
Year of manufacture	
Rated voltage	
Rated Frequency	
Type of condenser (water cooled/air cooled)	
Rated cooling capacity	
Rated COP	
Rated ISEER	

3. Test Results

S. No.	Schedule of Tests	Declared value	Measured value
	Cooling capacity kW (at 25% load)		
	Cooling capacity kW (at 50% load)		
	Cooling capacity kW (at 75% load)		
	Cooling capacity kW (at 100% load)		
	Power consumption at 25 % load		
	Power consumption at 50 % load		
	Power consumption at 75 % load		
	Power consumption at 100 % load		
	COP- (at 25% load)		
	COP- (at 50% load)		
	COP- (at 75% load)		
	COP- (at 100% load)		
	ISEER		

The scope of work of Contractor shall include suitable capacity of chillers with factory installed unit mounted VFDs as specified as per meeting functional requirements complete with R134 A/ R1233 zd (E) refrigerant (ozone friendly, HFC A1 category in ASHRAE classification), open / semi hermetic sealed single /multiple centrifugal compressors complete with single/twin refrigerant circuit, driven by suitable KW Squirrel Cage induction motor complete with water cooled shell & tube condenser, refrigerant cooled oil cooler only, insulated shell and tube flooded chiller, with S.S braided pipe flexible connector, insulation to be mechanically protected similar to chilled water piping insulation, flanged end for chiller & condenser, electronic auto setting water flow switches at condenser & chiller outlet, factory done refrigerant piping, refrigerant and oil first charged, microprocessor based control panel with non-volatile memory & color display, motor driven by chiller / unit mounted VSD/VFD with active harmonic filters with THDI less than 5% & accessories, factory installed electrical disconnect circuit breaker integrating main fuses etc. all mounted on M.S. frame. Motor shall be suitable for 415 volts \pm 10%, 50Hz \pm 5 %, three phase A.C. supply.

It should include flow switch/DP switch at chiller and condenser, Spring isolator, including oil separators, pressure relief devices, filter drier moisture indicators, refrigerant economizer if applicable, integral refrigerant piping and wiring, accessories as required and called for, automatic and safety controls mounted in central console panel.

IEEE519, 1992 recommendations shall be used for the basis of calculation of total active harmonic distortion (THD).

Suitable PCC/RCC foundation (PCC foundation in PCC (1:2:4) type B-1 using 20 mm graded stone aggregate 30 cm above floor level including making connection of inlet & outlet with fittings including nut, bolts, packing etc.) with plaster to be provided.

15 CODES & STANDARDS	
ASHRAE 15	Safety code for Mechanical refrigeration

ASHRAE 23	Methods of testing and rating positive displacement refrigerant compressors and condensing units.
ASHRAE 30	Methods of testing liquid chilling packages
ASME SEC VIII DIV I	Boiler and pressure vessel code
ANSI B 31.5	Code for refrigeration piping
AHRI 550/590 (2003)	Standard for Air Cooled Screw water chilling packages
AHRI 575	Standard for method of measuring machinery sound within an equipments space
ISO 1940	Mechanical vibration – Balance quality requirements of rigid rotors
ISO 10816-1	Mechanical vibration – Evaluation of machine vibration of measurements on non-rotating parts. General guidelines
	TEMA – C/R Heat Exchanger with acceptable deviation
	ASTM: C591 Specification for Polyurethane/ Poly iso cyanurate Foam

WATER COOLED CHILLER PACKAGE – DATA SHEET A		
S. No.	Description	Requirement
1.	Number Required	4 (3W+1S)
2.	Location	As per drawing
3.	Duty:- Continuous	(24 hrs/day) (Approximate)
4.	Capacity required at specified design conditions per chilling package	475 TR Capacity
5.	Refrigerant (as per ASHRAE A1 category in safety classification)	R134a/ R1233 zd (E)
6.	Maximum noise level at a distance of 1 meters as per AHRI 575	85 dBA
7.	Compressor – type	Semi-hermetic/Open centrifugal compressor
8.	Lubrication	Forced feed with an oil pump/ differential pressure
9.	Capacity control	Automatic
10.	EVAPORATOR	
10.1	Type	Shell and tube, flooded
10.2	Liquid to be cooled	Water
10.3	Chilled water quality	Potable water
10.4	Chilled water inlet temperature	13.33 Deg C/56 Deg F
10.5	Chilled water outlet temperature	6.7 Deg C/ 44 Deg F
10.6	Minimum chilled water flow per chilling package	@2.0 USGPM /TR
10.7	Fouling factor-water side (FPS unit)	0.0005
10.8	Chiller and suction line insulation	25 mm Closed cell polyvinylchloride foam
10.9	Maximum water side pressure drop	10m of water
11.	CONDENSER	

11.1	Type	Water cooled, Shell and tube
11.2	Liquid to be cooled	Water
11.3	Condenser water quality	Potable water
11.4	Condenser water inlet temperature	32.27 Deg C/90 deg F
11.5	Condenser water outlet temperature	37.83 Deg C / 100 deg F
11.6	Minimum chilled water flow per chilling package	@3 USGPM/TR
11.7	Fouling factor-water side (FPS unit)	0.001
11.8	Maximum water side pressure drop	10m of water
12.	Motor	415 V +/- 10%, 3 phase, 50 Hz
13.	Control Panel	Microprocessor based control panel
14.	Control panel to be interfaced with building automation system	BMS Card to be provided by chiller vendor
15.	Type of starter	Unit mounted VFD with active harmonic filter maximum THID of 5% at chiller source for all load
16.	Type Refrigerant	R134a/ R1233 zd (E)
17.	Star Label	Chillers shall be certified at the highest star level (5 star) under BEE. Incase no manufacturer is found to received 5 star level certification against their chiller, immediate lower star level shall be considered.
18.	COP & ISEER shall be considered with inclusion all losses such as VFD and AHF (Active Harmonic Filter).	

CHILLER PACKAGE -DETAILS TO BE FURNISHED BY TENDERER			- DATA SHEET B	
S. No.	Description	Tenderer Furnish	To	
1.0	Water Cooled Chilling Unit			
	General Data			
1.1	Number of chillers			
1.2	Location			
1.3	Make and country of origin			
1.4	Model number and year of introduction model from same factory			
1.5	Detailed list of installations of that model in India from same factory			
2.0	Operating Parameters			
2.1	Minimum refrigeration capacity (TR)			
2.2	Minimum chilled water flow rate (USGPM)			
2.3	Maximum chiller pressure drop (Feet of water)			

	2.4	Entering chilled water temperature (deg F)	
	2.5	Leaving chilled water temperature (deg F)	
	2.6	Evaporating temperature (deg F)	
	2.7	Fouling factor for chiller	
	2.8	KW/TR at full load conditions	
	2.9	Entering Condenser water temperature (deg F)	
	2.10	Leaving condenser water temperature (degF)	
	2.11	Fouling factor for condenser	
3.0		Compressor	
	3.1	Manufacturer	
	3.2	Model	
	3.3	Type of compressor	
	3.4	Speed (operating)	
	3.5	Speed (maximum)	
	3.6	Refrigerant used	
4.0		Evaporator	
	4.1	Manufacturer	
	4.2	Model (No)	
	4.3	Shell dia. (mm)	
	4.4	Tube length (m)	
	4.5	No of tubes (No.)	
	4.6	Material of tubes (Name)	
	4.7	Dia. of tubes (mm)	
	4.8	No of integral fins / cm (No.)	
	4.9	No of refrigerant circuits (No.)	
	4.10	No of water passes (No.)	
5.0		Compressor Motor	
	5.1	Manufacturer	
	5.2	Type	
	5.3	Motor Voltage	
	5.4	Rated output	
	5.5	Power characteristics	
	5.6	No of Motors	

6.0		Starter for Compressor Motor	
	6.1	Manufacturer	
	6.2	Type of starter	
	6.3	Active Harmonic Filters wiyh THDI at chiller source (must be < 5% (Yes or No)	
	6.4	Hot gas by pass/Environment stability control (Yes/No)	
7.0		Miscellaneous Details	
	7.1	Type of capacity control	
	7.2	Noise level of chiller (in dBA) at 1 m distance for loads	
	7.3	Equipments size (LXBXH)	
	7.4	Equipments operating weight (kg) / pounds	
	7.5	Full refrigerant charge quantity	
8.0		Documents to be furnished with bid.	
	8.1	Computerized printout (AHRI certified) from chiller manufacturer (without hot gas by pass/environment stability control) indicating power consumption in IKW/TR at	
	8.2	Catalogues furnishing detailed technical data for compressor, evaporator, condenser, VFD with active harmonic filter microprocessor or micro-computer control panel etc.	

D. WATER COOLED SCREW CHILLERS

1.0 GENERAL:

The contractor shall furnish and install where indicated on plans water cooled water chilling unit. The construction, performance and rating of the chillers shall be in accordance with latest ARI standard 550/ 590 -1998 and shall comply with ANS.B 9.1 safety code, National Electrical code section-VIII, division (1). Necessary 3 phase, 50 Hz, 415 volts, A.C. Power supply shall be made available for all units. The unit shall be guaranteed by chilling unit manufacturer to produce a capacity of not less than specified tons of refrigeration at specified leaving chilled water temperature, entering condenser water temperature, fouling factor. The chiller models offered should be either ARI or EUROVENT certified. All required data for the successful and efficient working of chiller plant optimizer shall be furnished by chiller supplier to BMS vendor. Compressor shall be chiller OEM make only. Third party assembled compressor will not be acceptable.

Performance will be certified in accordance with ARI Standard 550/590. Only chillers that are listed in the AHRI/ Eurovent Certification Program for screw are acceptable. Chillers shall be certified at the highest star level (5 star) under BEE. In case no manufacturer is found to received 5 star level certification against their chiller, immediate lower star level shall be considered.

1.1 Quality Assurance:

Compressor shall be dynamically balanced by the manufacturer and over-speed tested by the manufacturer at a minimum of 120% design operating speed. Each compressor assembly shall undergo a mechanical run-in test to check proper operation of various components and to verify that vibration levels, oil pressure/ temperatures, and efficiency are within acceptable limits. Each compressor assembly shall be pneumatically proof tested at 232 psig for R-134a and leak tested with a tracer gas at 185 psig.

Both cooler and condenser shall be proof tested at 232 psig for R-134a on the refrigerant side and leak tested with a refrigerant tracer gas at 185 psig or as per ASME Standards. The waterside of each heat exchanger shall be hydro-statically tested at 1.5 times the rated working pressure or as per ASME Standards

The entire chiller assembly shall be leak tested with a refrigerant tracer gas at 300 psig.

Prior to shipment the chiller controls shall be power tested to verify proper controls operation.

Chiller shall be furnished with unit-mounted starters for compressor motor and shall be factory tested under power to verify proper compressor rotation and proper starter operation prior to shipment.

1.2 Delivery, Storage and Handling:

Unit shall be stored and handled in accordance with manufacturer's instructions.

Unit shall be properly packed in wooden box secured tight on bottom planks with the help of bolts. Weatherproof wrapping shall also be provided to avoid damage during shipping. Lifting lugs shall be clearly indicated for the ease of handling.

Unit shall be shipped with all refrigerant piping and control-wiring factory installed.

Unit shall be shipped pre-charged with refrigerant and oil as specified on the equipment schedule. Unit shall be shipped with firmly attached metal plates that indicate name of manufacturer, chiller model number, chiller serial number and refrigerant used.

1.3 Warranty:

Warranty shall include parts and labour for two year after start-up. Rates for Annual Maintenance contract inclusive of labour and spares for three years after warranty period shall be quoted separately.

2.0 BASIC UNIT:

The unit shall consist in general of semi hermetic/ open Compressors, Microprocessor based automatic control panel, VFD starter, Necessary software and hardware for BMS connectivity thru Modbus, accessories and devices as listed. The AHRI Certified chiller package performance shall be tested as per LATEST AHRI standards 550-590. These shall be suitable for HFC-134a

refrigerant. The VFD shall be preferably same make as Chiller should be refrigerant/ hybrid cooled (refrigerant + air) type/as per OEM standard.

3.0 COMPRESSOR MOTOR ASSEMBLY:

- 3.1 Each unit shall have rotary screw bolted semi hermetic type compressors Horizontal/ Vertical type.
- 3.2 The rotary screw shall be manufactured from forged steel i.e twin/Mono screw construction. The profile of screws, shall permit safe operation upto a Speed of 3000 RPM for 50 HZ operation. The Compressor motor shall be as per manufacturer design conforming to minimum 95% efficiency.
- 3.3 The unit shall be complete with capacity control mechanism, to permit modulation between 25% to 100% of Capacity range. The compressor control mechanism shall have automatic spring return capability to ensure return of capacity control valve to minimum load position to ensure starting of compressor at minimum load. The manufacturer shall submit the load position at starting point. The compressor shall unload from fully loaded to the minimum capacity by means of a hydraulically actuated slide valve.
- 3.4 An oil separator shall be included to remove oil from the refrigerant and there shall be suitable heat exchanger for oil separation, if required.
- 3.5 The motor shall be suction or discharge gas cooled in case of semi-hermetic machines having redundant overload protection having thermal overload as well as current overload protection.
- 3.6 Economizer, if provided in the design capacity, shall be constructed out of corrosion resistant stainless steel plates so as to have turbulent flow and higher heat transfer area.
- 3.7 Compressor shall be fully field serviceable with full acoustical attenuation as per ARI standard 575 (latest) and easily serviceable type compressor safeties shall also include high compressor discharge temperature, high motor winding temperature, low oil pressure, reverse rotation, high discharge pressure, motor over load protection.

4.0 CONDENSER:

- 4.1 Even pass Condenser shall be of shell and tube type construction. Heat exchanger shall be fabricated with high-performance tubing, steel shell and tube sheets with cast-iron water boxes. Water boxes shall be nozzle-in-head types with integral flanged water connections.
- 4.2 Tubing shall be copper, high-efficiency type, with integral internal and external enhancement. Tubes shall be nominal 3/4" OD with nominal wall thickness of 0.025" measured at the root of the fin. Tubes shall be rolled into tube sheets and shall be individually replaceable. Tube sheet holes shall be double grooved for joint structural integrity. Cooler tubes shall be expanded into intermediate support sheets. Intermediate support sheet spacing shall not exceed 36 inches.
- 4.3 Water boxes and nozzle connections shall be designed for 150-psig maximum working pressure, unless otherwise noted. Nozzles shall feature standard ASA flanged connections.
- 4.4 Pressure relief valves shall be installed on the heat exchanger.
- 4.5 Water boxes shall have vents; drains and covers to permit tube cleaning. A temperature sensor shall be factory installed in each water nozzle.

5.0 COOLER:

- 5.1 The even pass cooler shall be direct expansion/ flooded/ hybrid falling film, shell and tube type, with steel shell and seamless copper tubes. The refrigerant head shall be removable type. The tubes shall be supported in the shell by adequate stiff supports to eliminate vibrations and noise. The tube ends shall be fixed firmly into the tube sheets to prevent leakage of refrigerant gas.
- 5.2 The cooler shall be tested against leaks and stamped in accordance with ASME/PV/GB code for the refrigerant being used and otherwise tested and constructed and tested in accordance with ASME or equivalent approved code requirements.
- 5.3 The cooler shall be factory insulated with 25.4 mm thick closed cell polyethylene/nitrile butile. Site insulation shall not be acceptable.

6.0 CONTROLS:

- 6.1 All the controls shall be factory wired and located in a suitable enclosure. These shall include fuses, selector switch, oil safety switch, high and low pressure cutouts, interlocks for crankcase heaters and inherent motor protection devices, recycling pump-down circuit, high discharge temperature cutout indicator lamps shall be provided for the compressor units. The control

center shall have a touch screen feature and graphical display. All in one glance access to chiller operating area.

- 6.2 Necessary starters for compressor motors shall be included and provided within the unit. The compressor, cooler and the condenser shall be electrically interlocked such that the compressor can run only when the water flow through both the heat exchangers is established. The Electrical panel must have suitable MCCB for electrical isolation with in main starter itself. The chiller shall have factory installed microprocessor control for various control functions.

6.3 Water Chilling Machine Control System (Microprocessor based control panel):

The water chilling unit shall be complete with microprocessor based type control system, which shall have the following features:-

- a. Self-diagnostic capability to locate faults and give early warning.
- b. Leaving chilled water temperature control and reset capability.
- c. Automatic sequencing of various functions for starting, running and stopping of the various components of the unit based on demand.
- d. A programmable microprocessor complete with key pad and LED display window to perform the above functions.
- e. The control package shall also consist of, but not limited to the following components:
 - ❖ Low control voltage to unit.
 - ❖ Field power and control circuit terminal blocks.
 - ❖ On/off switch.
 - ❖ Replaceable relay board.
 - ❖ Leaving chilled water set point board.
 - ❖ Diagnostic digital display module.
 - ❖ Microprocessor board.
 - ❖ Temperature reset board.

6.4 Service Function:

- a. Capacity control shall be by means of VFD. Load modulation shall be from 100% to 25% of full load without the use of hot gas by-pass under normal ARI condition. The slide valve control shall be precise, positioned by a PID (proportional- integral- derivative) control algorithm to ensure precise control (+/- .5 degree F) of desired chilled water temperature without hunting or overshooting the set point.
- b. The microprocessor control system shall include a programmed sequence to meet prelube and postlube needs prior to machine start-up and during coast-down after machine stop. The microprocessor shall automatically activate and interlock the chilled water pump; condenser water pump and cooling tower fans upon chiller activation.
- c. Upon request to start the compressor, the control system shall start the chilled water pump, condenser water pump and cooling tower fans; verify that flow has been established; and then compare leaving chilled water temperature with the chilled water set point. If the chilled water temperature is less than the chilled water set point, the control system will shut down the condenser water pump and wait for the cooling load to be established.
- d. The control system shall include two compressor timers to protect the motor from rapid cycling. The start-inhibit timer shall prevent rapid compressor restart by limiting the start time to 3 minutes minimum. In addition the compressor shall be inhibited from restarting from if more than 8 manual starts within a 12-hour period have occurred.
- e. The control system shall automatically cycle the compressor off to minimize energy usage whenever the leaving chilled water temperature is 5 degree F below the desired chilled water set point. The chilled water pump shall remain on, and when the leaving chilled water temperature rises above the set point by a user-configured amount, the compressor shall automatically be recycled back on. During the shutdown period, a message shall be displayed informing the operator a recycle restart is pending.
- f. The control centre shall monitor line voltage and if loss of voltage, high or low line voltage, or single cycle dropout is sensed, the chiller shall shut down. Upon restoration of line voltage, if the auto restart after power failure algorithm is enabled in the configuration mode, the chiller shall automatically restart and resume the mode of operation prior to shut down.

- g. The control centre shall allow reset of chilled water temperature set point based on water temperature rise across the evaporator. Optional input/output module shall be provided so the following can also be achieved:
- Chilled water reset based on 4-20 mA signal.
 - Chilled water reset based on a remote temperature sensor (such as outdoor air).
 - Remote start/stop.

When reset is active a message shall be displayed indicating the type reset in effect. The control centre will limit amp draw of the compressor to the rated load amps or to a value lower based on the following criteria:

Demand limit based on user input ranging from 40%-100% of compressor rated load amps.

Demand limit based on an external 4-20 mA signal.

When demand limit is active; a message shall be displayed indicating the source of demand signal.

- 6.5 The microprocessor based control system shall maximize both compressor and motor life by equalizing the number of starts and operating hours. The unit control module shall start the compressor with the least number of starts and turn off the compressor with most number of operating hours, thereby equalizing the starts and running hours and compressor wear.

6.6 Electronic Expansion Valve/ Refrigerant flow control:

The electronic expansion valve or other expansion valve shall offer the possibility of additional actions to control the operation of the chiller unit. This valve shall optimize filling of the evaporator. A sensor shall measure over-heating at the evaporator outlet to adjust the flow of the refrigerant fluid during operation. By means of Control logic, the electronic expansion valve shall ensure more stable operation when the load or pressure in the cooling circuit undergoes variations.

The electronic expansion valve shall not only be actuated by an oversize stepper motor, insensitive to the presence of particles in the circuit, it shall also be equipped with a self-diagnosis function. Each time the chiller unit shall start the expansion valve shall undergo a series of tests to ensure it will operate correctly.

The electronic module shall pre-position the expansion valve for each new operating state, so as to anticipate modification of operating parameters in a transient operating state.

6.7 Refrigerant Metering Device

Liquid refrigerant from the condenser shall be metered using a direct acting float-type metering device to maintain the proper liquid level of refrigerant in the heat exchangers under both full and part load operating conditions. Flow orifice shall have a liquid seal. The float device chamber shall have a bolted access cover to allow field inspection and float device shall be field serviceable.

The control logic should intervene in the compressor's capacity control function to ensure that the chiller unit operates to the maximum of the available capacity.

- 6.8 The control logic shall make it possible to keep the chiller unit in operation and provide the maximum available capacity to rapidly satisfy demand.

The control logic shall make it possible to rest the set point for water depending on the return water and ambient temperature without having to make use of external adjustment.

The microprocessor shall monitor the following parameters and shall have provision to be connected to a printer for generating operating logs at pre-programmed time interval:

- a. Entering and leaving chilled water temperatures
- b. Entering and leaving condenser water temperatures
- c. Evaporator and condenser refrigerant temperatures and pressures.
- d. Percentage line voltage.
- e. Compressor start and running hours.
- f. Active set points:

- ❖ Chilled water reset
- ❖ Current limit set point
- g. Part Failure diagnostics
- ❖ Water temperature sensors.
- ❖ Refrigerant temperature sensors.
- ❖ Compressor contactors status.
- ❖ Differential oil pressure switch.

It shall give audio alarm and screen display on equipment failure. Microprocessor control shall duly cycle the equipment, provide equal run time for all units and start the other compressor in case of failure of one unit.

7.0 REFRIGERANT CIRCUIT:

The refrigerant piping between compressors, chiller and condenser shall be of heavy gauge copper with brazed joints. The circuit shall include sight glass, moisture indicator, solenoid valves, electronic expansion valves/ metering devices, filter driers and necessary shut off valves with charging connections.

8.0 MISCELLANEOUS:

Each unit shall be provided with the following:

- 8.1 Necessary full charge of refrigerant gas and lubricating oil. Interconnecting refrigerant piping.
- 8.2 External Control of chilled water temperature through a 4-20mA signal from other source.
- 8.3 Main incoming power disconnect in the panel.
- 8.4 MS Joists, channels and all other building works required for installation and commissioning. Steel structure as required for assembling / manufacturing above equipment.
- 8.5 Spring vibration isolators below the unit rated by the isolator manufacturers to absorb 90% of unit vibration and as approved by the Engineer-In-Charge
- 8.6 Water flow switches at the outlet of chilling unit.

9.0 INTERLOCKS:

Manual / automatic Remote start.
Starting / stopping sequence.
Pre flow/past flow.
Compressor starter press interlock.
Pre start check of safeties & Alerts.
Low chilled water (load) recycle.
Hours / Number compressor starts & hours.
Manual reset of safeties.

10.0 INDICATIONS:

Chiller operating status messages.
Power on, pre start Diagnostic checks.
Compressor motor Amps.
Pre alarm alert.
Alarm.
Contact for remote alarm.
Safety shutdown messages.
Elapsed time (Hours of operation).
chiller input KW.
An operating configurable custom report.

11.0 SAFETY CUTOUTS:

Each of these protective limits shall have manual reset and cause an alarm message to be displayed at LCD screen informing the operator of shut down cause.

- Motor high temperature.
- Refrigerant high pressure.
- Refrigerant low temperature.
- CLube oil low pressure.
- Lube oil sump level.
- Compressor discharge temp. .
- Under voltage.
- Over voltage.
- Cooler and condenser water flow.
- Motor over current.
- Motor Acceleration time.
- Intermittent power loss.
- Compressor starter fault.
- Excessive starter transition time.
- Lack of motor current signal.
- Motor power supply phase reversal
- Temperature sensor and transducer faults.
- Single cycle drops out.
- Motor miswired.

12.0 CAPACITY CONTROL:

- Leaving and chilling water controls.
- Soft loading control by Temperature or load.
- Slide valve Actuator module.
- VFD Speed control
- Power (demand) limiter.
- Auto chilled water reset.

13.0 UNIT MOUNTED STARTER:

A VFD starter shall be supplied. The compressor motor starter shall be factory mounted, wired and tested prior to shipment by the chiller manufacturer.

Starters shall also include the following standard features:

- Factory fitted circuit breaker
- Ampere meter
- KWH meter
- KW meter

14.0 PERFORMANCE TEST:

- 14.1 Every chiller shall be tested in accordance with the latest version of IS 16590 with all amendments.
- 14.2 Every chiller shall accompany the manufacturer's energy performance software test reports in the Basic Model Group using the tool/software approved by any national or international accreditation or certification agency. The energy performance software report shall also contain the coefficient of performance values at 25 percent, 50 percent, 75 percent and 100 percent load and Indian Seasonal Energy Efficiency Ratio value as per the test methods and test conditions mentioned in Annex B of IS 16590. In addition to software-based test report, manufacturer is required to also submit the physical test report for parent model under each basic model group in respect of test results of Cooling capacity, Power Consumption and Indian Seasonal Energy Efficiency Ratio in accordance with the test conditions mentioned in IS 16590 with all amendments.
- 14.3 The performance tests shall be conducted in accordance with the standard rating conditions stated in Table no. 1 of clause 6 of IS 16590 with all amendments.

- 14.4 All the measuring instruments shall have accuracy as defined in Table no. 3 of clause 10 of IS 16590 with all amendments. Permissible variation in measurement of each measured quantity shall be in accordance with Table 3 of clause 10 of IS 16590 with all amendments.
15. Tolerance Limits:
- 15.1 The tolerances for Coefficient of Performance (full load and part load), Cooling Capacity (full load and part load) and Indian Seasonal Energy Efficiency Ratio shall be as specified in Table 2 of clause 7.1 of IS 16950 with all amendments provided the Coefficient of Performance declared by the manufacturers does not fall below the value specified in Table 1 and 2 of this order for water cooled and air-cooled condenser respectively.
- 15.2 Full load capacity and full load, part load Coefficient of Performance shall not be less than 100 percent of the rating minus the allowable tolerance calculated using the equation provided in Table 2 of Clause 7.1 of IS 16950 with all amendments.
- 15.3 There shall be no negative tolerance on the performance matrix; Indian Seasonal Energy Efficiency Ratio value specified for each star rating level and all tested equipment shall meet the minimum threshold for each star rating level.
- 15.4 All the values shall be recorded to three significant figures. The Indian Seasonal Energy Efficiency Ratio and Coefficient of Performance value shall be rounded off to two significant figures in accordance with IS 2: 1960 'Rules for rounding off numerical values (with all amendments)'.
16. Test report.–
The results of the chiller sample tested shall be reported on the prescribed format given in Annexure A.

Annexure A
[See paragraph 5]
Form for reporting the results of tests

(Separate test report format shall be used for each type/model)

Test Report No.

Date of Test Report:

4. General Information

Manufacturer/Laboratory name	
Address	
Date of receipt of sample by the test laboratory	
Laboratory Accreditation number	
Validity of the accreditation of the Test laboratory	
Tested by	
Approved by	
Date of testing	

5. Details of samples tested and rated values

Brand name	
Basic Model Group	
Model 1, Model 2, Model 3	
Serial number	
Year of manufacture	
Rated voltage	
Rated Frequency	
Type of condenser (water cooled/air cooled)	
Rated cooling capacity	
Rated COP	
Rated ISEER	

6. Test Results

S. No.	Schedule of Tests	Declared value	Measured value
	Cooling capacity kW (at 25% load)		
	Cooling capacity kW (at 50% load)		
	Cooling capacity kW (at 75% load)		
	Cooling capacity kW (at 100% load)		
	Power consumption at 25 % load		
	Power consumption at 50 % load		
	Power consumption at 75 % load		
	Power consumption at 100 % load		
	COP- (at 25% load)		
	COP- (at 50% load)		
	COP- (at 75% load)		
	COP- (at 100% load)		
	ISEER		

ASHRAE 15	Safety code for Mechanical refrigeration
ASHRAE 23	Methods of testing and rating positive displacement refrigerant compressors and condensing units.
ASHRAE 30	Methods of testing liquid chilling packages
ASME SEC VIII DIV I	Boiler and pressure vessel code
ANSI B 31.5	Code for refrigeration piping
AHRI 550/590 (2003)	Standard for Air Cooled Screw water chilling packages
AHRI 575	Standard for method of measuring machinery sound within an equipments space
ISO 1940	Mechanical vibration – Balance quality requirements of rigid rotors
ISO 10816-1	Mechanical vibration – Evaluation of machine vibration of measurements on non-rotating parts. General guidelines
	TEMA – C/R Heat Exchanger with acceptable deviation
	ASTM: C591 Specification for Polyurethane/ Poly iso cyanurate Foam

WATER COOLED CHILLER PACKAGE – DATA SHEET A		
S. No.	Description	Requirement
1.	Number Required	1 (1W)
2.	Location	As per drawing
3.	Duty:- Continuous	(24 hrs/day) (Approximate)
4.	Capacity required at specified design conditions per chilling package	125 TR Capacity
5.	Refrigerant	R134a
6.	Maximum noise level at a distance of 1 meters as per AHRI 575, 100-25% load	86 dBA
7.	Compressor – type	Semi-hermetic / Open screw compressor
8.	Lubrication	Forced feed with an oil pump/ differential pressure
9.	Capacity control	Automatic
10.	EVAPORATOR	
10.1	Type	Shell and tube, flooded
10.2	Liquid to be cooled	Water
10.3	Chilled water quality	Potable water
10.4	Chilled water inlet temperature	11.11 Deg C
10.5	Chilled water outlet temperature	5.55 Deg C
10.6	Minimum chilled water flow per chilling package	@2.4 USGPM /TR
10.7	Fouling factor-water side (FPS unit)	0.0005
10.8	Chiller and suction line insulation	25.4 mm Closed cell polyvinyl chloride foam
10.9	Maximum water side pressure drop	8 m of water
11.	CONDENSER	
11.1	Type	Water cooled, Shell and tube
11.2	Liquid to be cooled	Water
11.3	Condenser water quality	Potable water
11.4	Condenser water inlet temperature	32.27 Deg C
11.5	Condenser water outlet temperature	37.83 Deg C

11.6	Minimum chilled water flow per chilling package	@3 USGPM/TR
11.7	Fouling factor-water side (FPS unit)	0.001
11.8	Maximum water side pressure drop	8m of water
12.	Motor	415 V +/- 10%, 3 phase, 50 Hz
13.	Control Panel	Microprocessor based control panel
14.	Control panel to be interfaced with building automation system	Provision to be available
15.	Star Label	Chillers shall be certified at the highest star level (5 star) under BEE. In case no manufacturer is found to have received 5 star level certification against their chiller, immediate lower star level shall be considered.
16.	COP & ISEER shall be considered with inclusion all losses such as VFD and AHF (Active Harmonic Filter).	

CHILLER PACKAGE -DETAILS TO BE FURNISHED BY TENDERER			
S. No.		Description	- DATA SHEET B
			Tenderer Furnish To
1.0		Water Cooled Chilling Unit	
		General Data	
	1.1	Number of chillers	
	1.2	Location	
	1.3	Make and country of origin	
	1.4	Model number and year of introduction model from same factory	
	1.5	Detailed list of installations of that model in India from same factory	
2.0		Operating Parameters	
	2.1	Minimum refrigeration capacity (TR)	
	2.2	Minimum chilled water flow rate (USGPM)	
	2.3	Maximum chiller pressure drop (Feet of water)	
	2.4	Entering chilled water temperature (deg F)	
	2.5	Leaving chilled water temperature (deg F)	
	2.6	Evaporating temperature (deg F)	
	2.7	Fouling factor for chiller	
	2.8	KW/TR at full load conditions	
	2.9	Entering Condenser water temperature (deg F)	
	2.10	Leaving condenser water temperature (deg F)	
	2.11	Fouling factor for condenser	
3.0		Compressor	
	3.1	Manufacturer	

	3.2	Model	
	3.3	Type of compressor	
	3.4	Speed (operating)	
	3.5	Speed (maximum)	
	3.6	Refrigerant used	
4.0		Evaporator	
	4.1	Manufacturer	
	4.2	Model (No)	
	4.3	Shell dia. (mm)	
	4.4	Tube length (m)	
	4.5	No of tubes (No.)	
	4.6	Material of tubes (Name)	
	4.7	Dia. of tubes (mm)	
	4.8	No of integral fins / cm (No.)	
	4.9	No of refrigerant circuits (No.)	
	4.10	No of water passes (No.)	
5.0		Compressor Motor	
	5.1	Manufacturer	
	5.2	Type	
	5.3	Motor Voltage	
	5.4	Rated output	
	5.5	Power characteristics	
	5.6	No of Motors	
6.0		Starter for Compressor Motor	
	6.1	Manufacturer	
	6.2	Type of starter	
7.0		Miscellaneous Details	
	7.1	Type of capacity control	
	7.2	Noise level of chiller (in dBA) at 1 m distance for loads 100%, 75%, 50% 25%	
	7.3	Equipments size (LXBXH)	
	7.4	Equipments operating weight (kg) / pounds	
	7.5	Full refrigerant charge quantity	
	8.0	Documents to be furnished with bid.	
	8.1	Computerized printout (AHRI certified) from chiller manufacturer (without hot gas by pass/environment stability control) indicating power consumption in IKW/TR at	
	8.2	Catalogues furnishing detailed technical data for compressor, evaporator, condenser, microprocessor or micro-computer control panel etc.	

E. AUTOMATIC TUBE CLEANING SYSTEM

Control Panel:

The Control Panel system shall include IoT Ready, Industry 4.0 complaint device. The Panel should have minimum 7" Touch Screen Graphical HMI which will log the real time data related to chiller energy (KWH), capacity (TR), Chiller Water Flow monitoring, Water Temperature profile on evaporator and condenser both, compliances and graphical representation of historic summary which shall be displayed on the Mobile Application with unlimited user access on cloud based system. The data can also be retrieved in XL or PDF Format. The HMI should have depiction of injection and collection cycle. The alarms and faults shall be indicated on the screen in case of any issue in operation. Display must be Touch type, graphical presentation, and with multi-level security passwords with defined functional authorities. Field Devices like Energy Meter, Flow Meter, Temp. Sensors shall be picked up from BMS/CPO Scope of Supply & Data shall be replicated from skid via Modbus protocol.

Ball Trap:

The ball trap shall be mounted between two flanges - (BS Table 10 E) Grade B, 15 days 100 lbs capacity, at the outlet line of the condenser. The casing shall be made from a MS material of IS2062 Grade B. The Ball trap shall have epoxy based finished paint. The screen inside is made from stainless steel SS304L perforated metal sheet.

The Ball Trap should have pressure drop of less than 800 mm of WC. The body of the Ball trap shall be of size as nozzle or flange size or the pipeline size in which Ball trap must be installed. For example: if the pipeline size is 10 inches the Ball trap body should be of 10 inches.

The Ball Trap shall have Race Face Flange with gasket on only inner dial of pipe and should not be on the entire flange dia to avoid leakage.

Ball Collector:

The ball Collector shall be made of suitable size capable of storing all the sponge balls required and should be made from MS material of IS2062 Grade B. The Ball collector should have epoxy based finished paint. The Ball Collector should have a sight glass for monitoring the balls. Toughened glass should be used and should be mounted by Allen key fasteners or SS nut bolt.

Skid with Pumps & Valves:

The Common Skid should have pipe and flanges of MS material IS2062 Grade B. All welding of Skid shall be performed by Argon weld. The Skid frame should be of MS material of same IS2062 grade B. The Skid valves should be of diaphragm type or equivalent with all joints to be flanged and bolted. The valves used for injection and collection from respective chillers shall be of actuator type with minimum IP54 protection and less than 10s running time for open or close function with NEMA -II protection. The valve should be suitable to work in high humid environment up to 95% (Non-condensing) RH. All fasteners shall be of high-tension grade 9.8, 10.9, 12.9. Pumps shall be from reputed makes like Grundfos/Xylem/Amstrong. Motorized Valves shall be from reputed makes like Belimo/Danfoss/Siemens/JCI.

Working Principle - Activity Sequence:

The operation is based on the circulation of the sponge ball through the condenser tube. The sponge ball must be pushed to the condenser inlet in not more than 5 seconds by a high flow of water (min. 7L/S) which can be produced by a high-pressure source at least 2bar higher than the injection point at the condenser inlet. The source can be obtained by a single water injection pump in water injection system. Water injection system will be operated by a PLC controller which is pre-programmed to execute the cleaning process in two consecutive steps. There shall be ball injection cycle and ball collection cycle. The proposed system should be manufactured and complied with ISO 14001:2015, ISO 9001:2015. The system must be CE + RoHS compliant and in accordance with UL standards.

STEP 1:

The PLC shall activate the cleaning process by detecting the on/off status of the corresponding chiller (or condensing water isolating valve). If the chiller is on, the PLC shall command the control valves to open to manage the injection. The check valves shall be installed in the location as shown on the scheme above and as close as possible to the collector to ensure correct water flow direction during the injection cycle and the collection cycle.

STEP 2:

The injection cycle, the PLC shall command the injection control valve to open for couple of seconds (the collection control valve kept closed in the cycle) and then close. The water pressure from the pump shall be used to push the water inside the injector to the collector and force all balls in the collector to the condenser.

STEP 3:

The cycle shall be completed until the ball passing through the condenser where it should clean all the deposits on internal surface of the tubes. After leaving condenser the balls shall be trapped inside the ball trap unit.

STEP 4:

After the injection cycle is finished, the PLC shall command the collection control valve to open for couple of seconds (the injection control valve kept closed in the cycle) and then close. The negative pressure shall let the ball return from the ball trap unit back to the collector where the rinsing of the balls is carried out and then water is discharged to the outlet header of Condenser which goes to cooling tower. The ball shall wait in the collector until the next injection cycle. The time of the collection cycle is normally pre-set at 27 minutes.

1. A single pump should be on skid and shall be running during injection and collection cycles.
2. The pressure drop across ball trap shall not be more than 800mm.
3. The Valves shall give feedback to Control PLC of functioning.
4. The Control PLC shall raise an alarm in case of any malfunctioning of system
5. The total time of the whole cycle (injection and collection cycle) shall be 3 - 4 minutes.
6. A maximum number of 4 Condensers should be controlled by single skid and Control Panel. If the number of Condenser increases beyond 4, additional Skid with Control Panel should be considered and should be followed consequently.

F. ELECTROLYTIC BIO & SCALE REMOVER

System Description: Electro-chemical treatment system for cooling tower works in side stream without disturbing Cooling Tower Operations. The system should deploy an electrolysis reaction with controlled constant DC current which creates Electrolysis Reaction generating (-OH) Ions at Cathode which creates high PH on the walls of cathode, this results in precipitation of calcium and magnesium salts present in the water into the electrolytic reactor and Chlorine gas is generated at anode which acts like Biocide and avoids bacterial growth and algae formation. The system should be equipped with Automatic Self Cleaning Mechanism & Automatic Blowdown Control. The proposed system should be manufactured and complied with ISO 14001:2015, ISO 9001:2015. The system must be CE + RoHS compliant and in accordance with UL standards. The proposed system should minimize blow down water consumption up to 70%. No/Zero Chemicals uses for cooling tower circuit, technology must fall under green technology initiatives, the system must avoids algae and micro-bacterial formation in water or surface of Pipe/ CT/ fills. Self-treatment of Corrosion in the cooling water circuit, must extends life of the Cooling Tower Fills. The system must have below components:

1. **Electrolytic Reactor:** An electrolytic cell has three component parts: an electrolyte and two electrodes (a cathode and an anode). The electrolyte is usually a solution of water or other solvents in which ions are dissolved. Molten salts such as sodium chloride are also electrolytes. When driven by an external voltage applied to the electrodes, the ions in the electrolyte are attracted to an electrode with the opposite charge, where charge-transferring (also called faradaic or redox) reactions can take place.
2. **Automated Scrapper mechanism for reactor cleaning:** The Reactors need frequent cleaning and the system must be equipped with self-cleaning reactors to ensure zero down time and manual interventions.
3. **Automatic Blowdown control:** Automatic Blow Down feature allows only the required quantity blow down based on the real time monitoring of Chlorine, PH and conductivity. This feature in system ensures the drain valve operation and need no manual interventions.
4. **Side screen Filter:** The Side Screen filter is provided in side stream water coming out thru electrolyte process. This filter eliminates any particle in water to travel across. The possibility of scraped debris and substance are being avoided with the feature.
5. **Automatic Back wash:** Automatic Back wash is a feature of Side screen filter in which the filters are being cleaned automatically with the feedback of pressure drop. The motorized valves are provided to reverse the direction of water and the cleaning of side screen filter being taken care automatically.
6. **Control Panel:** This makes system Industrial 4.0 compliant and to be future ready (Optional Feature). The panel is monitoring status of individual cooling tower and modulating the water flow control valves. The real time monitoring of PH, TDS and Conductivity happen and any common to modulate DC current/Voltage/Drain/Back Wash/Scrapping and self-cleaning is initiated automatically. The panel will have 7" inches touch display with graphical representation.

Scope of Supply:

The scope of supply would be as given below:

1. Self-Cleaning Reactor with Anode and Cathode
2. Control Panel with PLC & Multicolor HMI
3. Circulation Pump
4. PH, TDS, Conductivity Meter for real time monitoring
5. Side Screen Filter with Pressure differential monitoring
6. Automatic Back wash & Blow-down Arrangement
7. Self-Scrapping mechanism
8. Motorized Valve
9. Manual Valves
10. Flow Switch and Pressure Gauge
11. Skid & Accessories

G. DX TYPE AIR COOLED PRECISION UNITS

1 SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of Precision Air Conditioning Units conforming to these specifications and in accordance with the requirements of Drawings and Schedule of Items.

2 TYPE

The precision Air Conditioning Unit shall be DX Air Cooled Type.

The Precision air-conditioning Unit shall be complete with microprocessor controller and shall consist of hermetically sealed Scroll compressors, Electronically Commutated EC evaporator motor, strip heaters/ Hot gas, post-heating coil with modulating control, humidifier, humidifier, condensate drain pan of Stainless Steel construction, LCD-touch screen resistive display for control and monitoring of the Unit functions, . The touch screen panel should be designed for easier man-machine interaction to makes screen browsing much more user-friendly. The display should be supplied with a LED bar featuring 8 different color notification, Electronic Expansion Valve, integral refrigerant piping and control panel duly wired to compressor and air/water cooled condenser all mounted on a steel frame. Micro-processor panel shall be BMS Compatible with open protocol for software integration. The Air cooled condenser with fan/ water cooled shell and tube condenser duly mounted on a common frame shall be installed on the wall openings / terrace with suitable angle iron / channel frame to be provided by contractor. The suitable starters, switches, power control cabling between Indoor unit and outdoor unit shall be included by the contractor.

3 CAPACITY

The refrigeration capacity and air quantity for the unit shall be as shown in Drawings and Schedule of Quantities. Manufacturer shall submit unit capacity software selection at tender design conditions.

4 CASING

The indoor & outdoor units shall be sectionalized / cabinet construction. Indoor units shall be consisting of compressor and motor, fan section, coil section, heater and humidification section, filter section, and drain pan. Each section shall be constructed of thick sheet steel all welded / bolted construction, adequately reinforced with structural members and provided with sufficient access panels for proper lubrication and maintenance. Base panel shall be constructed of fabricated steel structure provided with an under frame suitably braced. Drain pan shall extend under coil and fan sections with drain connections.

The indoor unit cabinet shall be of double skin sandwich panel construction (all four side) with 25 ± 2 mm thick panel made of galvanized steel,. The panels should be insulated with AO class insulation with Mineral wool of 32 Kg/CUM density, suitably treated for weather protection, corrosion resistant and shall be powder coated.

Units shall have hinged, quick opening access door in the fan & coil section and also in filter section where filters are not accessible from outside. Access doors shall be double skin type.

Outdoor unit shall consist of condenser coil and propeller type fan for air cooled unit as applicable.

5 COMPRESSOR & MOTOR

The compressor shall be hermetic sealed type and suitable for operation on Eco-friendly refrigerant R-410a. The compressor shall have dual pressure stat and an operating oil charge. The motor shall be suction gas cooled and shall be sealed against dirt and moisture.

The motor shall be suitable for $415 \pm 10\%$ V, 50 Hz, 3 Phases AC supply. The compressor shall be located in separate compartment isolated from air stream to permit servicing without shutting down the system. Compressor shall be installed on spring mounted floating platform /

rubber pads or manufacturers recommended approved mounting. Suitable overload protection shall be provided in compressor. Isolating valves shall be provided at suction & discharge. Compressor shall be fitted with electrically operated oil heaters/Crankcase heater with built-in thermostats and the heaters shall be automatically actuated when the compressor is stopped. In built TIME DELAY shall be provided for restart of compressor.

The compressor be Variable Speed Brushless DC Inverter Compressor. The compressor shall be capable of operation on part load by using Variable speed brushless DC inverter scroll compressor. The compressor should necessary provision of oil return on part load operations. There shall be single or double independent Refrigerant Circuits in the unit. Minimum one compressor should be scroll with inverter controlled brushless DC motor. The compressor should have integrated thermal overload protection and acoustic hood. Crankcase Heater on Compressor should be integral part of the unit. Compressors isolated from the air flow in the version with downward flow, and in the air flow in versions with upward output.

6 Refrigerant Circuit

Refrigerant piping and fittings within the unit shall be of copper and valves shall be of brass / gunmetal construction. Piping thickness shall be designed based on type of refrigerant and superheated gas pressure at full load, corresponding to ambient dry bulb temperature of 52°C.

The refrigeration system shall be of the multiple circuit direct expansion type and incorporate hermetic scroll compressors. The system shall include a manual reset high pressure control; auto reset low pressure switch, safety valve, and charging/access ports in each circuit

The refrigerant circuit comprises:

- Liquid receiver
- Delivery oil separator (with Variable speed Compressor)
- Electronic expansion valve
- Solenoid valve for shutting off the refrigerant liquid
- Refrigerant liquid flow indicator
- Solid cartridge freon filter
- Safety valve
- High pressure safety pressure switch with manual reset
- Low pressure switch with automatic reset
- Shut-off valves for external connections (versions with remote condenser)
- Copper refrigerant pipes with anti-condensation insulation on the suction line
- Pipe taps on suction and delivery side and charging valve on liquid side.

The serviceable / removable components shall have union connection for easily removal / assembly.

All external pipe work shall be carried out with 18G refrigerant quality copper tube and where bends are required; the same shall be completed using either a proprietary bending tool or radius fittings.

7 Electronic Expansion Valve

- The unit should have Electronic Expansion Valve, which offers the following advantages:
 - Fast, high precision adjustment of refrigerant flow;
 - Fast arrival of the unit at steady-state conditions;
 - Superheating value remains constant in variable thermal load conditions;
 - Efficient operating conditions of the compressor, especially in the presence of low room temperatures;
 - Wide working range with consequent extension of the unit's operating limits. These properties result in enhanced performance of the unit and make it possible to obtain very significant energy savings
- The Pressure transducers attached to the EEV shall be able to display real time pressure (Suction & Discharge) and Superheat on the Microprocessor panel.

- The Temperature Sensor attached to the EEV shall be able to display real time parameters of Refrigerant such as Suction & Discharge Temperature

8 EVAPORATOR SECTION

Evaporator coil shall be of fin and tube type having hydrophilic coated aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and air velocity across each coil shall not exceed 500 FPM. Tube shall be mechanically / hydraulically expanded for minimum thermal contact resistance with fins. The number of fins per cm. shall be 4 to 5.

A condensate drip tray of stainless steel construction of minimum 18 SWG thick, duly insulated shall be provided.

Dehumidification shall be achieved by reducing the air flow of the EC fans which thereby would reduce the ADP of the cooling coil to achieve dehumidification.

9 BLOWER SECTION

The unit shall be under floor / top discharge type and should be able to deliver between 500-600 CFM per ton. Total external static pressure shall be minimum 2.5 mm of WG for floor / top discharged units. Units with top discharge shall be designed for required static pressure as per actual ducting arrangement.

The units should be equipped with direct driven backward curved plug fans with electronically commutated brushless motors suitable for $415 \pm 10\%$ V, 3 Phase, 50 Hz AC supply. The motor's high efficiency should make for less energy absorption, especially at partial loads and during starting. The motor shall be of IP 54 or IP 55 grade. The fan shall be directly coupled having a maximum speed of 1400 r.p.m. The fan speed shall be controlled through microprocessor panel based on temperature & humidity set points. Fan motor assembly shall be statically and hydraulically balanced and designed for quiet operation.

10 HUMIDIFIER & HEATERS

The humidifier and heaters shall be a built in feature in each machine individually. Humidification shall be provided by boiling water in steam generator/infrared humidifiers with an efficiency of 0.75 kW/Kg/hr. The humidifier shall be self-cleaning and capable of delivering variable capacity steam from 30 % to 100% of its total capacity with help of microprocessor. The steam shall be evenly distributed into the supply air stream of the Air Conditioning Unit. The humidifier shall be fully serviceable with replaceable electrodes. Waste water shall be flushed from the humidifier by initiation of water supply valve via U-trap. The microprocessor should be able to display the current drawn and actual steam output in the microprocessor.

Heater should be of minimum two stages(above 6 TR) & heating circuit shall include dual safety protection through loss of air and manual reset high temperature controls. Modulating TRIAC Controlled heaters should be used in place of step heaters. Triac-controlled electric heaters can follow the condition of the room with accuracy, thus improving efficiency in heating and post-heating operation. With Variable Speed Compressor, the heaters shall be replaced by Hot gas, post-heating coil with modulating control as per design requirement.

Electric strip heaters shall be of the low temperature totally enclosed strip type fitted with radiation fins and suitable for operating at black heat. If overheating occurs, a safety thermostat should cut off the voltage supply to the heaters and triggers an alarm. Microprocessor should be able to control the humidification and heating through suitable sensors.

11 FILTERS

Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having anodised GI/aluminum frame. The media shall be supported with HDP mesh on one side and aluminum mesh on other side. Filter banks shall be easily accessible and designed for easy withdrawal and renewal of filter cells. Filter framework shall be fully sealed and constructed either from aluminum alloy or GI powder coated. Filter banks face velocities shall not exceed 150 Mt. / minute. The filter shall be suitable for high efficiency dust filtration of minimum MERV 8 / EU4.

12 AIR COOLED CONDENSER

Each condenser unit shall consist of a heat rejecting coil block constructed from copper tubes expanded on to straight aluminum fins. The coil shall be factory epoxy coated for protection against corrosive environment.

The fan shall be selected for low speed quiet operation. When compressor stops condenser fan shall also stop after a suitable time delay.

The condenser fan/s shall be of propeller type with max 1310 RPM variable voltage electric motor complete with IP-54 protection. Motor shall be speed controlled to ensure a stable operation for varying ambient; by a factory fitted direct/indirect acting head pressure activated step-less Fan Speed Controller.

The condenser shall be flexible for mounting in both horizontal and vertical positions. The entire assembly shall be supported by a corrosion treated frame having four legs.

13 ELECTRICAL SYSTEM

The electrical power system shall conform to relevant IS standard. A main isolator (MCB) shall be provided by the side of each unit, sized to meet the system total power requirement.

Within the panel individual power loads shall be distributed equally across the three phases.

All individual wires shall be of cross linked polythene insulated, armoured Copper cabling, with a low smoke and flame sheath (XLPE/SWA/LSF) and color coded or shall be numbered at their point of termination to facilitate servicing. Low voltage control wiring and power wiring shall be segregated from each other.

The following shall be incorporated:

- a. Contactors for automatic Micro Processor Control
- b. Single phase preventers
- c. Separate over load preventer for all individual components

14 Water Sensor

The system shall be provided with relevant water detection kit which shall have sensors. Each of the sensor must be capable to detect individually any water below the false floor near the unit, the sensor must be connected to the unit microprocessor thus enabling the controller to give an alarm in-case of wet floor

15 Air Flow Sensor

The unit should have inbuilt Air Flow Rate Feedback Sensor to display the real time Airflow rate and also to have fan modulation function based on Pressure differential or Airflow rate.

16 Supply Air Sensor

The unit should have inbuilt Supply Air Flow Temperature sensor to show real time Supply Air Temperature on the display of the unit.

17 Continuous Dynamic Optimization feature:

The controller should have function to control the optimization of the number of units in operation and energy consumption, based on the fan speed. The speed of the fans fitted in the units in operation should be kept within the most efficient operating band.

18 SAFETY CONTROLS

Following minimum safety controls shall be provided for each unit:

- a. High pressure trip - Manual reset (for each compressor)
- b. Low pressure trip - Manual reset (for each compressor)

19 SAFETY INTERLOCKS

Operation of heaters & humidifier shall be possible only when blower fan is in operation. Condenser fan shall stop after a suitable time delay on Compressor's stopping.

20 MICROPROCESSOR CONTROLS

Following information shall be available on the display on the units.

- a. Room temperature and humidity.
- b. Real Time Air Flow
- c. Supply air Temperature
- b. Supply fan working status
- c. Compressor working status
- d. Condenser fans working status.
- e. Electric heaters working status
- f. Humidifier working status.
- g. Manual / Auto unit status.
- h. Clogged Filter status
- i. Temperature set point.
- j. Humidity set point.
- k. Working hours of main component i.e. compressors, fans, humidifier etc.
- l. Unit working hours.
- m. Current date and time.
- n. Type of alarm (with automatic reset or block)
- o. The last 100 intervened alarms.

The microprocessor shall be able to perform following functions:

- a. Testing of the working of display system.
- b. Password for unit calibration values modification.
- c. Automatic re-start of program.
- d. Cooling capacity control.
- e. Compressor starting timer.
- f. Humidifier capacity limitation.
- g. Date and time of last 100 intervened alarm.
- h. Start / Stop status storage.
- i. Random starting of the unit.
- j. Outlet for the connection to remote system.
- k. Temperature and humidity set point calibration.
- l. Delay of General Alarm activation.
- m. Alarm calibration.

21 Connectivity

Unit shall have a Modbus RS485 serial port for reading and writing purposes along with a RJ45 port for IP communication, including a reading and writing Modbus TCP/IP. Supervision via WEB should be available with the RJ45 port. When the machine IP address is queried via web browser from any computer connected to the same local network to which the units are linked, access should be gained to the unit web page (password-protected access).

H. AIR COOLED SPLIT AIR CONDITIONING UNITS (Energy saving Inverter type compressors)

1. SCOPE

The scope of this section comprise the supply, erection, testing and commissioning of Air Cooled Split Units with inverter driven compressors conforming to these specifications and in accordance with the requirements of Drawings and Schedule of Quantities. The BEE star rating of the units shall be as per the Schedule of Items.

2. TYPE

The Split Units shall consist of hermetically sealed compressor, motor, air cooled condenser, strip heaters, integral refrigerant piping and wiring, all mounted on a steel frame. Indoor unit to be installed for Split Unit within building, shall be housed in insulated cabinet consisting of cooling coil, blower with motor, filter & insulated drain pan. Split unit must deliver specified capacity after taking into account losses due to piping length & site conditions.

3. CAPACITY

The refrigeration capacity of Packaged Unit and Room Air Conditioners, split unit shall be as shown on Drawings and in Schedule of Item.

4. COMPRESSOR AND MOTOR

Compressor shall be hermetically sealed, swing type, serviceable type and shall have dual pressure stat, and an operating oil charge. The motor shall be suction gas cooled and shall be sealed against dirt and moisture. The motor shall be suitable for $415 \pm 10\%$ / volts or $230 \pm 6\%$ volts, 50 Hz, A.C. supply.

5. REFRIGERANT PIPING AND CONTROLS

Refrigerant piping and fittings interconnecting compressor condenser shall be all copper and valves shall be brass / gunmetal construction. The refrigerant used shall be ozone friendly HFC.

6. CASING

The indoor & outdoor units shall be sectionalised / cabinet construction. Indoor units shall be consisting of fan section, coil section, filter section, and drain pan. Outdoor unit shall consist of condenser coil, fan & compressor. In case of package units, the compressor shall be mounted within the indoor units and in case of split unit, the compressor shall be mounted with the outdoor units. Each section shall be constructed of thick sheet steel all welded / bolted construction, adequately reinforced with structural members and provided with sufficient access panels for proper lubrication and maintenance. Base panel shall be constructed of fabricated steel structure provided with an under frame suitably braced. Each unit shall include one piece drain pan constructed of 20 gauge galvanised sheet steel plate or stainless steel. Drain pan shall extend under coil and fan sections with drain connections. Removable panels in fan and coil sections shall provide access to all internal parts. Panels shall be internally lined with 2.5 cm thick fibreglass as per section "Insulation" for the thermal insulation and acoustic lining.

7. FAN MOTOR AND DRIVE

Fan motor shall be suitable for $415 \pm 10\%$ volts or $230 \pm 10\%$ volts, 50 Hz, A.C. Supply, Single phase, motors shall be provided with permanent capacitor. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 rpm.

8. FAN

Fan wheels and housing shall be fabricated from heavy gauge steel. Fan wheels shall be of double-width, double inlet forward-curve, multi-blade type enclosed in a housing and mounted on a common shaft. Fan housing shall be made of die-formed steel sheets with stream-lined inlets to ensure smooth air flow into the fans, fan shaft bearing shall be oil/grease lubricated. All rotating parts shall be dynamically balanced individually, and the complete assembly shall be statically and hydraulically balanced. Fan speed shall not exceed 1000 rpm and maximum fan outlet velocity shall be 550 meters per minute.

9. COOLING COIL

Cooling coils shall be of fin and tube type having aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and air velocity across each coil shall not exceed 100 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory-tested at 21 Kg. per sq.cm air pressure under water. Tube shall be mechanically / hydraulically expanded for minimum thermal contact resistance with fins. The no. of fins per cm. shall be 4 to 5.

10. VIBRATION ISOLATORS

The indoor and outdoor units shall be provided with ribbed rubber pad vibration isolators.

11. PAINTING

Split units shall be factory finished with durable alkyd spray enamel. Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, then coated with enamel paint to match the finish over the adjoining shop-painted surface.

12. PERFORMANCE RATING

The unit shall be selected for the lowest operating noise level. Capacity rating and power consumption with operating points clearly indicated shall be submitted with the tenders and verified at the time of testing and commissioning of the installation.

i. Refrigerant should be R-4R10A, Noise level should be less than 40Db, with wireless remote controller LCD type with LED panel display, with sleep mode, auto restart, auto air swing (up-down), high EER Rotary, dual protection & 3M micro protection filters.

I. VRF/VRV System:

1. SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of Variable Refrigerant Volume System. The system selected is a modular system, with number of indoors connected to centrally located outdoor units. The outdoor units for all the system shall be air cooled type. For Guest House

2. TYPE

Unit shall be air cooled, variable refrigerant volume air conditioner consisting of one outdoor unit and multiple indoor units. Each indoor unit having capability to cool independently for the requirement of the rooms. All indoor units shall be provided with isolation valves so that a particular unit can be isolated and removed for servicing, while system keeps functioning in normal way. All the units shall be suitable for operation with 415 V +/- 10%, 50 Hz + 3%, 3 Phase supply for outdoor units; & 220 V +/- 10%, 50 Hz +/- 3%, 1 Phase supply for indoor units.

It shall be possible to connect multiple indoor unit on one refrigerant circuit. The indoor units on any circuit can be of different type and also controlled individually. Following type of indoor units shall be connected to the system:

- Ceiling mounted cassette type.
- Ceiling mounted ductable type.
- Wall mounted Hi-Wall type.
- Floor mounted type.

The outdoor unit shall be pre-charged with first charge of refrigerant. Additional charge shall be added as per refrigerant piping at site.

3. OUT DOOR UNIT

- i. Outdoors units of the VRV system shall be compact air cooled type, factory assembled, weather proof casing constructed from heavy gauge mild steel panels with powder coated finish
- ii. The outdoor unit should comprise of Inverter controlled Twin Rotary Compressor/ Scroll Compressor
- iii. Each module of outdoor unit must have at least 50 % of Variable compressor which can work on Part load Suitable to operate at heat load proportional to indoor requirement.
- iv. The ODU must deliver COP of minimum 5.5 at 50 % load.
- v. The outdoor units must be suitable for up to 225 m refrigerant piping between outdoor unit & the farthest indoor units. Allowable level difference between outdoor unit & indoor units shall be 50 m in case of outdoor unit on top & 40 m in case of outdoor unit at bottom.
- vi. Allowable level difference between various indoor units connected to one out door unit shall be up to 15 m.
- vii. The outdoor units shall be suitable to operate within an ambient temperature range of 5 Deg C to 43 Deg C in cooling mode; & -20 Deg C to 15 Deg C in heating mode.
- viii. The entire operation of outdoor units shall be through independent remotes of indoor units. No separate Start/ Stop function shall be required.
- ix. Complete refrigerant circuit, oil balancing/ equalizing circuit shall be factory assembled & tested
- x. In case of outdoor units with multiple compressors, the operation shall not be disrupted with failure of any compressor.
- xi. The noise level shall not be more than 60 dB (A) at normal operation measured horizontally 1m away and 3.5 m above ground level.

i. Compressor

The compressor shall be high efficiency scroll/ rotary type and capable for capacity controlling. It shall change the speed/ refrigerant mass flow rate in accordance to the variation in cooling

load requirement. Refrigerant mass flow rate can be changed by speed modulation of compressor. System shall incorporate liquid sub-cooling mechanism with liquid injection at intermediate pressure.

All inverter shall be IGBT (insulated gate bipolar transistor) type for efficient and quiet operation.

All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated. Forced lubrication may also be employed.

Oil heater shall be provided in the compressor casing.

ii. Heat Exchanger

The Heat Exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fan coil and larger surface area.

The fins shall have anticorrosion treatment for Heat Exchanger Coil. The treatment shall be suitable for areas of high pollution, moisture and salt laden air.

The casings, fans, motors etc. shall also be with anticorrosion treatment as a standard features.

The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical / horizontal discharge. Each fan shall have a safety guard.

iii. Refrigerant Circuit

The Refrigerant Circuit shall include an liquid receiver /accumulator, liquid & gas shut off valves and a solenoid valve. All necessary safety devices shall be provided to ensure the safety operation of the system.

iv. Safety Devices

All necessary safety devices shall be provided to ensure safe operation of the system.

Following safety devices shall be part of the outdoor unit:

- High pressure switch,
- low pressure switch,
- fuse,
- crankcase heater,
- fusible plug,
- over current protection for inverter, and
- Short recycling guard timer.

v. Refrigerant Piping

a. All connections of Refrigerant piping shall be in high grade Copper of Refrigeration quality with Eddy Current Testing and material test Certificates.

b. All connections, tees, reducers etc. shall be standard make fittings.

c. All refrigerant pipes and fittings shall be type 'L' hard drawn copper tubes and wrought copper fitting suitable for connection with silver solder. The copper thickness of wall shall be 20G/ 22G (0.7 to 1 mm)

d. All joints in copper piping shall be swaged joints using low temperature brazing and/ or silver solder. Before jointing any copper pipe or fittings, its interior shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while construction of the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

e. Refrigerant lines shall be sized to limit pressure drop between evaporator and condensing unit to less than 0.2 kg per Sq.cm.

f. After the refrigerant piping installation has been completed the refrigerant piping system shall be pressure tested using nitrogen, Pressure shall be maintained on the system for 24 hours.

g. The system shall then be evacuated and held for 24 hours

h. All refrigerant piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturers.

- i. For outdoor piping, the finish shall be woven GRP Mat finished with coloured Epoxy paints to withstand outside ambient conditions and UV Radiation.
 - j. Insulation of pipes shall be carried out with insulation tubes of appropriate thickness so that condensation does not occur.

- vi. Oil Recovery System

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigerant piping.
System shall be designed for proper oil return to compressor along with the distribution of oil to individual compressor.
The refrigerant piping shall be extended upped 100 M with 50-M level difference without oil traps.

4. SPECIFICATIONS OF INDOOR UNITS :

The units include pre-filter, fan section and DX coil section. The housing of units shall be light weight powder coated galvanized steel. Units shall have external casing of ABS Plastic for supply and return air.

5. INDOOR UNITS

Units shall be factory assembled, wired, piped and tested.
Units shall have DX coils with copper tubes and bonded aluminium fins for highly efficient heat transfer.
Units shall have Centrifugal fans for adequate amount of Air circulation and low Noise.
Units shall have inlet filters, which are easily cleanable and replaceable.
All components of Units are easily accessible for connection, repairs and maintenance.
Units shall have very low noise.
All units with Factory manufactured Units, Grills shall have auto swing feature for proper Air distribution.
All units shall be controlled by electronic Expansion Valves operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room
All units mounted inside the ceiling shall have fans capable of sustaining duct connections, and special filters if necessary.
Visible indoor units shall have wireless remotes. Price of the same shall be included in cost of unit by default.
Concealed indoor units shall have sensor mounted on supply air grilles / diffusers which can be controlled with wireless remotes.
Anticorrosion treatment for avoiding corrosion of coils.
All units shall have adequate insulation or Lining to avoid condensation.
Cooling coil and refrigeration parameters shall be designed in such a way that supply air temperature shall not be less than 14C or 10C above room dew point temp, whichever is more. Contractor shall guarantee inside conditions with selected supply air temperature.

6. CEILING MOUNTED CASSETTE TYPE UNIT (MULTI-FLOW TYPE)

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX-coil section. The housing of the unit shall be powder coated galvanised steel.
The body shall be light in weight and shall be possible to suspend from four corners.
Unit shall have an external attractive panel for supply and return air. Unit shall have four way supply air grilles on sides and return air grille in centre.
Each unit shall have **high lift drain pump**, fresh air intake provision, low gas level detection system and very low operating sound.
Unit must be insulated with sound absorbing thermal insulation material, Polyurethane foam.
The sound pressure level of unit at the highest operating level shall not exceed 46dB(A).

7. CEILING MOUNTED DUCTABLE TYPE UNIT

Unit shall be suitable for ceiling mounted type. The unit shall include pre filter, fan section & DX-coil section. The housing of unit shall be light weight powder coated galvanized steel. The unit shall have high static fan for ductable arrangement. Each unit shall have **high lift drain pump**.

The Sound Pressure level of unit at the highest operating level shall not exceed 38 dB (A), at a vertical distance of 1.5 m below the units with duct connected to the unit.

8. HIGH WALL MOUNTED UNITS

The units shall be high wall mounted type. The unit shall include pre-filter, fan section & DX-coil section. The housing of unit shall be light weight powder coated galvanized steel.

Unit shall have an attractive external casing for supply and return air.

The sound pressure level of unit at the highest operating level shall not exceed 46dB(A).

9. FLOOR MOUNTED UNITS

The unit shall be suitable for floor mounting. The unit shall include, pre-filter fan section, DX. Coil section. The housing of unit shall be light weight powder coated galvanized / anodized aluminum panels. Unit shall have an attractive external casing with supply & return air grilles.

10. CENTRAL REMOTE CONTROLLER

A multi-functional microprocessor based centralized controller (central remote controller) shall be supplied as an optional accessory.

The controller shall be able to control upto min. 64 zones of 64 groups (each group consisting of max.16 units) or 128 nos. of indoor units with the following functions.

- Temperature setting for each zone, or group, or indoor unit.
- On/Off as a zone or individual unit.
- Indication of operating condition.
- Select ON of all operation modes for each zone..

The controller shall have wide screen liquid crystal display and shall be wired by a non-polar 2 wire transmission cable to a distance of 1000m away from the indoor unit.

The controller shall be integrated to BAS system thru software for monitoring & controlling of all above parameters including start/ stop of each indoor / outdoor unit. All necessary interface cards / units should be supplied as a part of the system to integrate to the BAS Software.

11. CONDENSATE DRAIN PIPING:

All pipes to be used for condensate drain shall be PVC pipe conforming to IS: 4985 Class I & all joints should be Gluing or solvent cementing as per manufacturer recommendation. U-trap shall be provided at the end Mounting

All indoor units shall be mounted with Brackets; Hangers etc. with proper size anchor Fasteners

12. ELECTRICAL INSTALLATION

For Variable Refrigerant flow systems, power will be provided near outdoor unit location. HVAC Contractor to provide suitable distribution panel along with 3-phase power to outdoor units and single phase power to all indoor units fed by these outdoor units. Power/ control cabling along with supports shall be included.

V Installation:

- a. The units shall be mounted on ribbed rubber pads for vibration isolation. The contractor shall supply the required charge of refrigerant, lubricant and other consumables, for commissioning and testing of the equipment.
- b. All the equipment shall be thoroughly tested and checked for leaks. All safety controls shall be suitably set and a record of all setting shall be furnished to the project supervisor.

- c. Providing and fixing M.S. structural support for condensing unit with vibration isolator pad in-between support and structure and vibration isolation suspender and pads for evaporating units shall be in scope of contractor.

J. COOLING TOWERS(FRP construction)

1.0 Scope

The scope of this section comprises the supply, erection testing and commissioning of cooling towers in accordance with requirement of tender Drawing and bill of item.

2.0 Type

Cooling tower shall be open circuit single/ twin cell, Induced draft side suction Cross Flow Cooling tower in accordance with requirement of tender drawings and of the bill of item.

Cooling towers shall meet the following.

- Cooling Tower shall be CTI certified for construction, thermal performance and Sound and shall carry relevant certification label.
- Sound performance shall be in accordance with CTI ATC-128
- Heat rejection Performance shall be in accordance with ASHRAE 90.1- 2016
- Cooling tower shall be OSHA certifies for safety standard & CQC Certified for water savings

Performance (Power) requirement should be minimum as per ASHRAE 90.1 – Standard 189.1 and higher performance if specifically required as per bill of quantity.

- Seismic design requirements shall be in accordance with relevant provisions of IS Code/ National Building Code of India.

3.0 Induced Draft Cooling Tower

Cooling tower shall be FRP type suitable for outdoor use. Tower shall be vertical Induced draft / forced draft with cross flow type. Cooling Tower shall be FRP / Zinc Coated steel (Min G-235/ Z-700) Grade Galvanization/SS 304/ SS 316 construction, in rectangular/ square/ circular/ profile, complete with fill, fan, motor, water distribution system, eliminators, steel supports. Sound attenuation equipment as called for in bill of quantities.

3.1 Capacity & Performance

The cooling tower capacities shall be as per the tender drawing and the bill of item. Performance required for cooling tower should not be more than 50 HP when tested according CTI ATC-105 procedure.

3.2 Casing

3.2.1 FRP casing

The casing shall be made out of FRP construction of suitable thickness and UV retardant fibre glass reinforced polyester stabilized with finished surface outside and smooth surface in side. It shall have sufficient structural strength to adequately withstand high wind pressure of not less than 0.99 psf and seismic load upto 0.9 g> class 8 on any external surface and vibration.

The tower supporting structure shall be made out of, Hot dipped galvanized steel framework of suitable thickness. Galvanizing process shall be carried out in accordance to ISO 1461: 1999 standard with minimum galvanization thickness equivalent to G-235/ Z-700 grade.

3.2.2 Zinc Coated Steel/ SS 304/ SS 316 casing

The Structure shall be made out of zinc coated steel / SS304/SS316 construction. Galvanized sheet steel shall comply with ASTM A 653/ A 653 M and the zinc coating on galvanized steel shall conform to G-235/ Z-700. All the joints should be sealed watertight. Fasteners should be of corrosion resistance zinc or cadmium coated bolts or tapings screws for assembly with galvanized steel washers, neoprene backing where required for preventing leaks. Welded connections should be continuous and watertight. It shall have sufficient structural strength to adequately withstand high wind velocities and vibration as specified above.

3.3 RCC Basin

The casing may be installed in the reinforced cement concrete basin if so identified in tender drawing or in the bill of quantities otherwise standard FRP basin shall be provided of suitable thickness. RCC suction tank with easily removable double brass strainers may be provided with this basin.

3.4 Cold Water Basin

Cold water basin construction shall be of the same material as of casing and shall be of minimum 300 mm depth or as per manufacturer standard, so as to hold the shut-down volume of water. Cooling tower super structure shall be supported on Cooling Tower Basin. Basin shall be constructed and installed to ensure that air will not be entrained in outlets when operating and water will not overflow on shutdown. Each individual basin shall be provided with an individual outlet. The outlet shall be from the bottom.

Cooling tower shall be provided with factory mounted sweeper piping inside water basin complete with filtration system.

Basin fitting shall include the following:

- a. Bottom/side outlet.
- b. Screened suction assembly.
- c. Drain connected to the side / underside of basin
- d. Overflow connected to the side / underside of basin.
- e. Built-in bleed off attached to inlet header discharging through polyethylene tube into overflow pipe.
- f. Quick fill connected to the side of basin.
- g. Equalizing line
- h. Each cell is provided with one make-up valve with unsinkable float arranged for operation level. The make-up valve should be suitable for water supply pressures between 15 psig (103 kPa) and 50 psig (345 kPa). The make-up valve shall be made of copper and the float ball of SST304.

3.5 Distribution System

Hot Water distribution system shall be open basin, with spray nozzles spaced for even distribution of water over fill surface. System shall be self- draining and non-clogging. Spray nozzles, shall be cleanable stainless steel, bronze or high impact plastic, non-clog, removable type properly spaced for even distribution. Cover shall be provided for entire nozzle area or flume / trough area so that it is not exposed to the ambient environment thus making the system more hygienic and free from dust and bacteria. The hot water basin covers shall be provided to prevent debris from entering the hot water basin, ensuring reliability of the system. They also assist in lowering sound levels.

3.6 Cooling Tower Fill

Fills shall be of PVC hanging type for cross flow technology resistant to rot, decay and biological attack and thermo vacuum formed design to facilitate for an even spread of water over fill heat transfer surface. Fill sheets shall be suspended from tower deck structure under side & shall be elevated above the floor of the cold water basin to facilitate cleaning and easy replacement for cross flow towers. Fill shall be arranged in such a manner to ensure negligible resistance to air flow and eliminate water spots and prevent fouling through scales that may form. Fills shall having thickness of minimum 13 mil thickness The fill shall be suitable for entering water temperatures up-to and including 130 deg F.

The Fill with integral louvers and integral drift eliminators are formed from self-extinguishing (per ASTM D-568) polyvinyl chloride (PVC), having a flame spread rating of 5 per ASTM Standard E84-77a, and are impervious to rot, decay, and fungus or biological attack.

The eliminators are designed to effectively strip entrained moisture from the leaving airstream with a minimum of air resistance.

3.7 Drift Eliminator

In order to reduce carry-over losses through entrainment of moisture drops in air stream, UPVC drift eliminator shall be installed to limit drift losses to less than 0.0009% of the total water circulated.

3.8 Mechanical Equipment

The tower shall be provided with low speed fan driven thru Multi grooved V belt/ Direct / Gear reducer to achieve sound noise level specified. Direct driven fan speed shall not exceed 700 rpm.

Fan shall be axial propeller type light weight rotor fitted with multiple aero foil blades with extruded aluminum / aluminum alloy / FRP construction for induced draft towers.

Fan shaft bearing of the self-aligning, grease lubricated ball or roller bearings with moisture proof sealed and premium moisture resistance grease suitable for between minimum 29 deg C and 149 deg C temperatures. Tube axial fan shall be provided for forced draft cooling tower. The fan shall be installed in closely fitted cowl for maximum efficiency. The entire fan assembly shall be statically and dynamically balanced. Fan shall be driven by 415±10% volts, 3 phase, 50 cycles, AC supply, energy efficient IE-3 totally-enclosed, Air Over (TEAO) with IP 55 / air over motor (TEAO), weather-proof construction to operate in humid air stream. The motors should be VFD compatible. Fan shall be protected by a fan guard of galvanized steel Construction to prevent birds from nesting during idling period and shall be easily accessible for inspection and maintenance. The mechanical equipment assembly shall be adequately supported on a rugged steel/ FRP base assuring vibration-free support.

The sheaves should be aluminum alloy, if located inside the airstream. The bearings shall be heavy duty, self-aligning pillow block with extended lubrication lines to side access door for easy lubrication. Minimum L 10 life for bearings shall be 75,000 Hours
A mechanical vibration cutout switch shall be provided to de-energize the motor in case of excessive vibrations

Noise levels. The noise shall be as per Bill of Items and the CTI Certified performance curves shall be submitted.

Provide sound attenuators, if necessary to meet the noise criteria specified.

3.9 Internal walkway/ Service platforms

Access door constructed of UV retardant FRP / openable grilles/ louvers shall be provided to enter into inner section of the cooling tower for inspection, cleaning and maintenance.

An internal walkway with ladder and elevated working platform or working platform constructed out of fill media duly supported from the bottom shall be provided to service the motor and drive.

3.10 External Ladder to Top of Unit & Handrail unit:

A galvanized ladder is provided to access the top of the unit. The elevated platform shall be provided over the top of the cooling tower so that person can go to the top of the tower for easy maintenance. The ladder & Handrail should meet pertinent OSHA standards and ships loose for field installation by others.

4.0 Performance Submittals

- Manufacturer shall submit certificate from CTI validating capacity and sound performance of cooling tower at tender design conditions (entering and leaving condenser water temperature, entering air wet bulb temperature, water flow rate, fan kW).
- In addition, manufacturer shall also provide certificate that the cooling tower, accessories and components withstand the seismic force as per zone defined by National Building Code of India.
- Sound level along with sound curves and characteristics of sound attenuators, if required to meet the noise criteria.
- Manufacturer shall submit complete performance rating and power consumption at varying loads & varying outdoor wet bulb temperatures. The same shall be verified at the time of testing and commissioning of the installation.

5.0 Testing at Site

Capacity of the cooling tower shall be computed from the measurements of the water flow, incoming/ outgoing water temperatures and ambient air wet bulb temperature using accurately calibrated mercury –in-glass thermometers. Computed ratings shall conform to the specified capacities and quoted ratings. Power consumptions for cooling towers shall be computed from measurements of incoming voltage and input current.

COOLING TOWER – DATA SHEET A			
S. No.	Description	Requirement	Requirement
1.	Number Required	4 (3W+1S)	1 (1W)
2.	Location	As per drawing	As per drawing
3.	Duty:- Continuous	(24 Hrs/day) (Approximate)	(24 Hrs/day) (Approximate)
4.	Wet bulb approach	less than 2.77°C	less than 2.77°C
5.	Capacity at	17,95,952 K.CAL/Hr	4,72,619 K.CAL/Hr
6.	Maximum noise level at a distance of 3 meters	Less than 75 dBA	Less than 75 dBA
7.	Motor efficiency	(IE-3) VFD Controlled	(IE-3) VFD Controlled
8.	Ladder material	GS ladder	GS ladder
9	WBT(Actual)-29.5 Deg C WBT (Design) -30.5 Deg C	30.5 Deg C	30.5 Deg C
10	Cooling tower In Temp (Deg C) Out Temp (Deg C)	38.83 Deg C 33.27 Deg C	38.83 Deg C 33.27 Deg C
11	Flow Rate	1425 gpm	375 gpm

TITLE COOLING TOWER – DATA SHEET B DETAILS TO BE FURNISHED BY TENDERER		
S. No.	Description	Requirement
1.	Manufacturer	
2.	Type	
3.	Model	
4.	Wet bulb approach	
5.	No. of Fans / HP	
6.	Overall dimensions (mm)	
7.	Weight with water (kg.)	
8.	Outlet velocity (mts. Per min)	
9.	Tip speed (Mts per min)	

10.	Drift loss (LPH)	
11.	Total water loss (LPH)	
12.	Noise level at a distance of 3 meters	
13.	Capacity	
14.	Motor efficiency	

K. VARIABLE & CONSTANT SPEED PUMPING SYSTEM – SPECIFICATIONS (Motors Efficiency IE-3 rated with VFDs)

Variable Primary Water Pumps (Sensorless) & Variable Hot Water Pump (Sensorless)

Split Coupled Vertical Inline Pump

Supply and install of Split Coupled (long coupled) Type Vertical In-Line Centrifugal pumping unit. The pumps shall be radially split, single stage centrifugal type with CI/GM casing with equal size suction and discharge flanges and having separate tapped flush line and pressure gauge connections, Gunmetal Bronze (BS1400 LG2C) dynamically balanced impeller, stainless steel shaft, lower carbon throttle bushing, outside/inside Balanced type mechanical seal with Resin Bonded Carbon rotating face, Sintered Silicon Carbide stationary seat and Viton secondary seal. Pump shall be PN-16 ratings. Motor efficiency shall be high efficiency IE-3 type.

Pump shall be complete with all accessories like pressure gauge, butterfly valves & Suction guide at pump suction reducers (if reqd.). Pump discharge shall have Tripple duty valve & butterfly valves. All the valves and fittings shall be PN-16 at 50 Deg C. Suction guide & Tripple Duty Valve has to be sourced from pump manufacturer only.

Pump Construction: Pump Casing - Cast Iron with PN16 pump for working pressure Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.

Impeller - Stainless steel/ Equi, fully enclosed type. Dynamically balanced. Two-plane balancing is required where installed impeller diameter is less than 6 times the impeller width.

Shaft - Provide Stainless Steel pump shaft.

Coupling - Rigid spacer type of high tensile aluminum alloy. Coupling to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and replacement without disturbing other components of the pump or motor. The coupling shall be provided with a fully enclosed guard complying with the Machinery Directive.

Mechanical Seals - Shall be Stainless Steel multi-spring outside/inside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. Provide a 316-stainless steel gland plate.

The pump is to be fitted with a factory installed flush line. Supply in the flush line to the mechanical seal, a 50 micron cartridge filter (alternatively, a cyclone separator when pump differential pressure exceeds 30 PSIG) and floating ball type sight flow indicator suitable for the working pressure encountered. The mechanical contractor shall change the filters after the system has been flushed and on a regular basis until the pumps are turned over to the owner. The squirrel cage induction type motor, with TEFC enclosure and shall be connected to the pump through a high tensile aluminum, split type spacer coupling to permit Servicing of the mechanical seal without disturbing pump, motor or electrical wiring. Coupling shall be protected by a guard

Integrated Variable Frequency Drive (VFD) (For Sensorless Variable Pumps)

Integrated VFD on pumps means that the VFD shall be mounted directly on the pump so that all the critical information like flow, Head shall be displayed real time for each pump. Also this will help in smooth commissioning of pumps as per site requirements and the complete system shall be easy to operate.

1. Fundamental Requirements

VFD shall be of the VVC-PWM type providing near unity displacement power factor ($\cos \phi$) without the need for external power factor Correction capacitors at all loads and speeds.

VFD shall incorporate DC link chokes for the reduction of mains borne harmonic currents to reduce the DC link ripple current thereby increasing the DC link capacitors lifetime. VFD shall be CE Marked showing compliance with both the EMC Directive 2004/108/EC and the Low Voltage Directive 2006/95/EC.

RFI filters shall be incorporated within the drive to ensure it meets the emission and immunity requirements of EN61800-3 to the 1st Environment Class C1 (EN55011 unrestricted sales class B).

2. VFD and Motor Protection

VFD and motor protection shall include: motor phase to phase fault, motor phase to ground fault, loss of supply phase, over voltage, under voltage, motor over temperature, inverter overload, over current. Over current is not allowed ensuring Intelligent variable speed. Units will not overload the motor at any point in the operating range of the unit.

3. User Interface

VFD shall incorporate an integrated graphical user interface that shall provide running and diagnostic information and identify faults and status in clear English language. Faults shall be logged / recorded for interrogation at a later date. VFD shall display dynamic head and flow on the VFD.

It shall be possible to upload parameters from one VFD into the non-volatile memory of a computer and download the parameters into other drives requiring the same settings.

The keypad shall incorporate Hand-Off-Auto pushbuttons to enable switching between remote and manual control.

The VFD shall be multi-color 4.3" back-lit touch-screen for Variable Pumps must be provided with a cloud-based subscription service that enables Active Performance Management. It must proactively track and manages pump performance and provides early diagnostic messaging, web accessible trends and analysis along with automated reports helping end customer to make performance-based decisions and take immediate action to deliver the best possible HVAC pump performance. The cloud based subscription should deliver real-time alerts, such as Alarms & warnings on excessive vibration, Pump in hand, Dead head, Cavitation, Broken Coupling. The connectivity kit supplied by OEM should have ability to connect upto 8 pumps in a single plant room

4. Control Algorithm

a) Control software (Sensor-less) shall be embedded in the Integrated Variable control unit to provide automatic speed control in variable volume systems with/ without the need for differential pressure. The default operating mode under Sensor-less Control shall be 'quadratic pressure control' whereby head reduction with reducing flow will be according to a quadratic control curve. Control mode setting and minimum / maximum head set-points shall be user adjustable via the inbuilt programming interface.

b) If the quantity of pumps in a system is 5 to 6 maximum, including any standby, a controller shall be added to a pumping unit and set up at the factory to operate in parallel mode. The pump controls, which will be linked on site by the control contractor, will automatically stage the units, as appropriate, to maintain the best efficiency pumping and minimum operating cost. The standby unit will be brought into the rotation to exercise and equalize wear. The sequence of controls and staging points will be submitted to the engineer for approval at the time of order.

c) Serial Communications: The VFD shall incorporate a USB port for direct connection to a PC and / or an RS485 connection with Modbus RTU protocol.

d) Optional protocols available should include BACnet if required

e) Other Control Features

The VFD shall have the following additional features:

- Override for BMS
- Manual pump control or closed loop PID control
- Programmable skip frequencies and adjustable switching frequency for noise / vibration control
- Auto alarm reset
- Motor pre-heat function
- Minimum three programmable digital inputs
- Minimum one analogue inputs
- One programmable analogue / digital outputTwo volt-free contacts
- System Control – Sensorless Control and Multiple Pumps with Pump logic control.

Pump Controller

The variable pumps shall have an independent/ standalone IP-54 controller and should not be an integral part of any of the pump VFD's. The controller shall be designed to control up-to 6 pumps.

The pump controller should be designed and programmed for Efficiency based staging whereby the controller ensures that all the pumps are running in the most energy efficient mode.

Mechanical and Electrical Details

1. The pump logic controller shall be specifically designed for the control of multiple pumps in HVAC hot and/or chilled water systems that involve up to 6-variable speed pumps, with Control, in parallel, staged, sequenced, and standby configurations. The pump logic controller shall allow field adjustments of control parameters as described below.
2. The controller shall be capable of accepting, processing and displaying appropriate signals from the individual pump controls for the following values:

System Status

- Total flow
- Head
- Total power
- Pumps speed
- Alarm
- Wire to water efficiency (calculated)
- Number of pumps running
- Lead pump number

Individual Pump Status

- Speed Ref (%)
- Speed (%) (rpm)
- Run time (hrs)
- Fault Nbr
- Run status (running/stopped)

Individual Pump control status

- Current (Amps)
- Volts (VAC)
- Power (kW)
- Head
- Flow

3. The pump logic controller shall be suitable for indoor or outdoor applications and shall be capable of being integrated with Intelligent Variable Speed pumping units for pumping packages approved to UL 778 & CSA STD C22.2 No 108 standards and also suitable for wall mounting with separate Intelligent Variable Speed pumping units and stand-alone pump controls.
4. The controller shall have 3-levels of password security, first level to view only (No password required); the second level is for field adjustable parameters and the third level for factory/commissioning setup parameters.
5. The controller shall stage the pumping units to ensure optimum pumping energy usage and shall sequence the pumps starting order, including any standby unit.
6. The controller shall be fed with a power supply from each pumping unit controls in the control 'daisy-chain' so that a loss of power to any pump unit controls will not affect the controller pumping operation. Should the controller go off-line, all pumps in auto-preset mode will operate together to provide the correct system flow needs. Staging of the units will resume as the controller is brought back online.

Controller shall be provided with a cloud-based subscription service that enables Active Performance Management. It must proactively track and manages pump performance and provides early diagnostic messaging, web accessible trends and analysis along with automated reports helping end customer to make performance-based decisions and take immediate action to deliver the best possible HVAC pump performance. The cloud based subscription should deliver real-time alerts, such as Alarms & warnings on excessive vibration, Pump in hand, Dead head, Cavitation, Broken Coupling. The connectivity kit supplied by OEM should have ability to connect upto 8 pumps in a single plant room

BMS communication

- a. The controller shall be capable of serial communication with a BMS with either of the following protocols:
 - Modbus RTU/ BACnet MS/TP
- b. The following points will be available through all protocols:
 - Flow for each pump

- Head for each pump
- Total real-time power consumption
- Pump speed
- Individual pump run status
- Alarm
- Number of pumps operating
- Remote start/stop
- Controller on/off status
- Pump hours of operation

Operations of Sensorless pump & Efficiency based Staging

Dedicated microprocessor based pump logic controller, parallel pumping software duly downloaded, sensorless logic, interfacing amongst all components and compatibility of I/O signals, BMS compatible etc complete with other accessories as required. It should be complete as per manufacturer's Specifications VFD shall be capable to operate on Sensorless Control application along with controller. Controller(IP-54) should have parallel pump logic to operate all set of the pumps with the following features

- Parallel pump operation for power savings.
- Controller shall control pump VFD's as per building load variation.
- The bypass line shall be controlled with the pump controller

Microprocessor controller shall not be mounted on any of the VFD and should be standalone system to have equipment's better performance/ Efficiency and reliability.

Supply a controller to control the pumps to satisfy all system settings at the minimum speed possible and at maximum efficiency under any flow conditions. Pump curves showing the staging points to maintain maximum efficiency shall be supplied with the submittal data.

SENSORLESS OPERATION: Sensorless control is an innovative concept in circulating pumps. Pump performance and characteristic curves for different speeds are embedded in the memory of the speed controller during manufacture. This data includes power, pressure and flow across the flow range of the pump. During operation, the power and speed of the pump are monitored, enabling the controller to establish the hydraulic performance and position in the pumps head-flow characteristic.

These measurements enable the pump to continuously identify the head and flow at any point in time, giving accurate pressure control without the need for external feedback signals. Patented software technology within the controller ensures trouble-free operation in all conditions. Incorporating the pumps hydraulic data into the controller and removing sensors results in true integration of all components and removes the risk of sensor failure.

DEFAULT OPERATING MODE – QUADRATIC PRESSURE CONTROL

The default control mode for Sensorless pumps Quadratic Pressure Control where the controller is set to control the speed according to a 'control curve' between max and min flow. It is widely recognized that fitting a differential pressure sensor at the most remote load, across the supply piping and return piping encompassing the valve & coil set, is the best installation scheme for energy efficiency. Sensorless pumps can replicate this control without the need for the remote sensor. As the flow required by the system is reduced, the pump automatically reduce the head developed according to the pre-set control curve.

Parallel Sensorless & efficiency based solution shall be provided to improve the performance of multi pump system, with True best efficiency staging of multiple vertical in-line pumps.

Integrated controls employing Parallel Sensorless pump control technology. Redundancy at both the mechanical (multi-pump system) and control levels. If the controller is damaged, the sensorless pump control embedded in the integrated drives continues to adjust the speed of operating pumps as needed to serve system demand.

Constant Condenser Water Pumps

Split Coupled Vertical Inline Pump

Supply and install of Split Coupled (long coupled) Type Vertical In-Line Centrifugal pumping unit. The pumps shall be radially split, single stage centrifugal type with CI/GM casing with equal size suction and discharge flanges and having separate tapped flush line and pressure gauge connections, Gunmetal Bronze (BS1400 LG2C) dynamically balanced impeller, stainless steel shaft, lower carbon throttle bushing, outside/inside Balanced type mechanical seal with Resin Bonded Carbon rotating face, Sintered Silicon Carbide stationary seat and Viton secondary seal. Pump shall be PN-16 ratings. Motor efficiency shall be high efficiency IE-5 type.

Pump shall be complete with all accessories like pressure gauge, butterfly valves & Suction guide at pump suction reducers (if reqd.). Pump discharge shall have Tripple duty valve & butterfly valves. All the valves and fittings shall be PN-16 at 50 Deg C. Suction guide & Tripple Duty Valve has to be sourced from pump manufacturer only.

Pump Construction: Pump Casing - Cast Iron with PN16 pump for working pressure Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.

Impeller - Stainless steel/ Equi, fully enclosed type. Dynamically balanced. Two-plane balancing is required where installed impeller diameter is less than 6 times the impeller width.

Shaft - Provide Stainless Steel pump shaft.

Coupling - Rigid spacer type of high tensile aluminum alloy. Coupling to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and replacement without disturbing other components of the pump or motor. The coupling shall be provided with a fully enclosed guard complying with the Machinery Directive.

Mechanical Seals - Shall be Stainless Steel multi-spring outside/inside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. Provide a 316-stainless steel gland plate.

The pump is to be fitted with a factory installed flush line. Supply in the flush line to the mechanical seal, a 50 micron cartridge filter (alternatively, a cyclone separator when pump differential pressure exceeds 30 PSIG) and floating ball type sight flow indicator suitable for the working pressure encountered. The mechanical contractor shall change the filters after the system has been flushed and on a regular basis until the pumps are turned over to the owner. The squirrel cage induction type motor, with TEFC enclosure and shall be connected to the pump through a high tensile aluminum, split type spacer coupling to permit Servicing of the mechanical seal without disturbing pump, motor or electrical wiring. Coupling shall be protected by a guard

CENTRIFUGAL PUMPS-DATA SHEET A

Design Parameters	S.N	Pump Designation	Primary Chilled Water Pumps (With VFD)/ Condenser Water Pumps/ Hot Water Pumps (With VFD)
	1	No. of Pumps	Primary Chilled Water: 950gpm, 45mt # 4nos : 300 gpm, 45mt #2nos Condenser:1425 gpm, 24 mt # 4nos 375 gpm, 24mt # 2nos Hot Water: : 90 gpm 38mt#3nos
	2	Design Capacity	Primary Chilled Water: 950gpm 80% Efficiency : 300 gpm, 75% Efficiency Condenser:1425 gpm, 80% Efficiency 375 gpm, 75% Efficiency Hot Water: 90 gpm #3nos, 65% Efficiency
	3	Total Head	Primary Chilled Water: 950gpm 45mt # 4nos : 300 gpm, 45mt #2nos Condenser Water:1425 gpm, 24 mt # 4nos 375 gpm, 24mt # 2nos Hot Water: 90 gpm, 38mt #3nos
	4	Location	AC plant room & reheat pumps on terrace of hospital.
	5	Max. Rated Sped (AT 50 Hz)	1450 RPM / 2900 RPM(As per designer discretion)
Features of Construction	6	Liquid Handled	Water
	7	Type of Pump	Vertical Inline Long Coupled
	8	Seal	Mechanical
	9	Nozzle Orientation	Side Suction & Side Discharge
Materials of Constructions	10	Flange Drilling	As per ISI
	11	Parts	Material
	11.1	Impeller	Stainless steel / Equi
	11.2	Casing	Cast Iron
	11.3	Shaft	Steel

CENTRIFUGAL PUMPS- DETAILS TO BE FURNISHED BY TENDERER DATA SHEET B

S. No.	ITEM DESCRIPTION	
1.	Make	
2.	Model	
3.	Design Capacity	USGPM (M3/ Hr)
4.	Total Head	FT WG (MWC)
5.	Shut off head	FT WG (MWC)
6.	Hydrostatic test pressure	KG/SQCM (MWC)

7.	Pump efficiency at duty point	%	
8.	Power input to pump at duty point	(BHP) (KW)	
9.	Motor efficiency at duty point	%	
10.	Power input to motor at duty point	(HP) (KW)	
11.	Rated speed	RPM	
12.	NPSH required	FTWG (MLC)	
13.	Material of construction as per specifications		YES / NO
14.	Suction size		
15.	Discharge size		
16.	Impeller type		
17.	Pump weight	Kg	
18.	Pump set weight	Kg	
19.	Pump size	mm	
20.	Pump Foundation size	mm	

L. HEATING SYSTEM - HOT WATER GENERATOR

1. SCOPE

This section of the specification covers the supply, installation, testing and commissioning of hot water generator along with its accessories, conforming to these specifications and in accordance with requirements of drawings and of the 'Schedule of Item'.

2. CODES AND STANDARDS

The design, manufacture, testing and performance of the Hot Water Generator shall comply with all currently applicable statues, regulations and safety codes in the locality where it is to be installed. The Hot water generator shall also conform to the latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the contractor of this responsibility.

3. CONSTRUCTION

The hot water generator shall be vertical/horizontal type comprising of steel shell, heating elements, controls, control panel, mounting frame etc.

i. Shell

The shell shall be of welded construction, fabricated from 10mm thick MS sheet with electric fusion welded seams & in accordance with ASME Boiler & Pressure Vessel Code, Section IV. The shell shall be complete with baffles to provide adequate velocity to water.

ii. Mounting Frame

The hot water generator shall be mounted on a robust fabricated steel frame of 16 SWG (1.6 mm) MS sheet and complete with hinges, locks to make a compact assembly. The base frame shall be designed & fabricated out of required MS sections and shall be suitable for level foundation.

A drain shall be provided at the lower end and outlet and inlet connections with flanges shall be on upper end lower side. Connections for safety wall and controls shall be provided on the top. A required no. of sockets for heater elements shall be provided. The construction shall conform to the Indian standards/international standards

iii. Heating Element

Sheathed tabular electric resistance type heater elements shall be of approved make and made of chromium coated mild steel mounted in electrically resistant u-tubes and shall be immersion type to be in direct contact with water and connected for equal loading.

i. These shall be easily removable without opening the terminal plates.

ii. Heaters shall be of adequate rating and equally distributed for uniform heat transfer.

iii. No. of Banks

UP TO 75KW

Min. 3 Banks

UP TO 200KW

Min. 4 BANKS

ABOVE 200KW

Min. 5 BANKS OR more

Heating elements shall be suitable for 415 V +/- 10%, 3 phases, 50 Hz, AC supply and conforming to IS.4159.

The Hot water generator should have at least 5% spare heater capacity, which can be used in case of failure of running heater.

iv. Control Panel

The control panel shall be fabricated out of 2mm MS sheet built in with the hot water generator.

Microprocessor based step controller with thermister sensor to control the HWG in stages. Features of this control should include dip switch programming, status LED's. Step controller shall have built in test mode to verify Load wiring, contactors and stage operations with 1 Sec time delay. A separate power controller shall be provided for proportional control (0-100% load), in between the switching on and off of step control stages for precise temp. control up

to 250KW and above 250KW a microprocessor based step controller with thermister sensor to control the HWG in stages.

The HWG shall be BMS compatible and RS-485 Communication port shall be provided for remote programming and control.

v. Insulation

The hot water generator shall be insulated with 50-mm thick fiberglass of density 32 kg/cu.mt. and clad with 0.63mm thick aluminum sheet on MS frame welded to generator body.

vi. The hot water generator shall be provided with lifting lugs on top for easy transportation and handling.

4. PRESSURE TESTING

The Boiler Shall Be Tested In the factory for leak at a Hydraulic Pressure of 350 psi.

5. CONTROLS AND ACCESSORIES

One 100 mm dial type thermometer, mercury in bulb type, at inlet and outlet with tubing. Range of thermometer shall be 0-100 Deg c.

One dial type pressure gauge with globe valve at inlet and outlet of the boiler with tubing. Pressure gauge shall have range of 0-10 kg/sq. cm.

Spring loaded safety valve for pressure relief in case of high-pressure build up in the Hot Water Generator. The outlet of safety valve shall be piped to the nearest drain.

- Inlet and outlet connections with matching flanges.
- Drain connection with 25mm-gate valve.
- De-scaling valve
- Automatic air vent valve
- Step controller.
- High temperature cutout
- Electronic low water level switch.
- Vibration isolators with at least 90% efficiency.

6. CONTROL PANEL

The hot water generator shall be provided with electrical control panel, factory mounted directly on mainframe, completely wired and tested. The panel shall conform to Indian I.E rules.

The panel shall be provided with accessories. Conforming to the approved list of makes. The panel shall be suitable for 415 V +/-10%, 3ph, 50 Hz AC electric supply.

The control panel shall comprise of: -

- (a) Incoming MCCB of suitable rating.
- (b) Copper/Al. bus bar of suitable size
- (c) Ammeter with current transformers and selector switch.
- (d) Voltmeter with selector switch
- (e) Contactors
- (f) On/ Off indication lamps for individual banks.
- (g) Phase indication lamps with control fuses.
- (h) Fault indication lamps.
- (i) On/Off toggle switch for operating individual banks.
- (j) Alarm with reset push button.
- (k) Push button for lamp test and heater reset.
- (l) Copper connection with cables and control cabling.
- (m) Microprocessor based step controller
- (n) Hot Water Generators shall be completely BMS compatible having Potential free Dry contacts for :

- i. System On/Off status indication

- ii. Low Water Level Trip
- iii. Hi. Temp. Trip
- iv. Auto/Manual Selector Mode
- v. Start/Stop Command
- vi. RS-485 Communication port for remote programming and control

The doors of electrical controls panel shall be openable only when incoming power supply is cut off.

7. PAINTING

All external welds should be de-rusted, cleaned and applied with two coats of necessary red oxide primer. Then it shall be powder coated with Siemens grey RAL7032 shade.

8. TESTING

The unit shall be tested at site to ensure the specified output of hot water generator after satisfactory installation.

9. DATA / INFORMATION:-

The data sheet A, as below, indicates the parameters for manufacture/fabrication of Hot water generator. The contractor shall complete the data sheet B & submit as a part of his technical submittal at appropriate stage.

HOT WATER GENERATOR - DATA SHEET A

S. N.	Description	Requirement	
1.0	Design Features	Hospital General Areas	Critical Areas
1.1	Application	Winter Heating	RH Control & Heating
1.2	Minimum capacity	350 KW	120KW
o	Location	AC Plant room	AC Plant room
1.4.	Numbers Required	3Nos. (2W+1S)	3Nos. (2W+1S)
2.0	Features of Construction		
2.1	Type	Vertical / Horizontal suitable for Indoor application	Vertical / Horizontal suitable for Indoor application
2.2	Heaters	Chromium Coated MS	Chromium Coated MS
3.0	Material construction of		
3.1	Shell	10 mm thick MS	10 mm thick MS
3.2	Dished ends	15 mm thick MS	15 mm thick MS
4.0	Insulation		
4.1	Material	Fiberglass	Fiberglass
4.2	Thickness	50 mm	50 mm

4.3	Density	32 KG / cum	32 KG / cum
4.4	Finish	(0.63 mm) 24 G Aluminium cladding	(0.63 mm) 24 G Aluminium cladding
5.0	Testing		
5.1	Hydrostatic test	At 350 PSIG for leaks	At 350 PSIG for leaks
5.2	Performance test	Standard running test	Standard running test

HOT WATER GENERATOR - DATA SHEET B

S.No.	Description	
1	Application	
2	Make	
3	Design Capacity	KW
4	Type	
5	Model	
6	Banks	No / KW
7	Vessel size	Mm
8	Thickness	
8.1	Shell	(mm)
8.2	Dished ends	(mm)
9.0	Insulation	
9.1	Material	
9.2	Thickness	(mm)
9.3	Density	(Kg/CUM)
9.4	Finish	
10.0	Dimensions (L x W x H)	(mm)
11.0	Heaters	
11.1	Make	
11.2	Model	
12.0	Electrical Characteristics	
13.0	Test Pressure	
14.0	Controls	
14.1	All provided	YES / NO
14.2	Any deviation from specification (Please indicate specifically)	YES / NO
14.3	Qty: Reqd.: Nos:	
14.4	Mandatory service clearance required.	

M. HORIZONTAL /VERTICAL FLOOR MOUNTED AIR HANDLING UNITS (General Area)

1. SCOPE
The Scope of this section comprises the supply, erection, testing and commissioning of air handling units conforming to these Specifications and in accordance with requirements.
2. TYPE
The air handling units shall be double skin modular, draw through type comprising of various sections such as mixing chamber (wherever R .AIR and F.AIR are ducted.), pre filter section, chilled water coil section, fan section supply air plenum as per details given in Drawings and design requirement.
3. CAPACITY
The air handling capacities, maximum motor HP, static pressure shall be as shown on Drawings and as per design requirement'.
4. CASING
Double skinned panels shall be 40+/-2 mm thick Double Skin Panels with thermal break profile, shall be made of 0.8mm Pre-coated GSS on outside and 0.8mm Galvanized sheet inside with 275 GSM galvanized coating for corrosion resistance and with CFC - FREE P.U. insulation of 42 (+/- 5%) kg/Cu M injected in between with an internal gasket between the skins to interrupt the thermal bridge of the panel. Outer sheet of panels shall be made of galvanized pre-coated sheet of 0.8 mm thickness.

The entire framework shall be mounted on an aluminium alloy or galvanized steel or heavy duty engineering composite material (depending on size) channel base as per manufacturer's recommendation. Panels shall be assembled together to form an enclosure that is capable of low air leakage potential, conforming to class A of EN 1886:2007. Handles shall be made of hard nylon and all access panels should be openable with Allen key arrangement. Units supplied with various sections shall be suitable for onsite assembly with continuous foam gasket. All fixing and gaskets shall be concealed.
5. Mixing Box
AHU's requiring mixing boxes as specified in drawings shall be complete with fresh and return air dampers.
6. Damper
Dampers shall be opposed blade type. Blades shall be made of double skinned aero foilaluminum sections with integral gasket and assembled within a rigid extruded aluminum alloy frame. All linkages and supporting spindles shall be made of aluminum or nylon, turning in teflon bushes. Manual dampers shall be provided with a bakelite knob for locking the damper blades in position. Linkages shall be extended wherever specified for motorized operation. Damper frames shall be sectionalized to minimize blade warping. Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure.
7. Motor and Drive
Fan motors shall be energy efficient (IE-3) and shall be 415±10% volts, 50 cycles, three phase, totally enclosed fan-cooled class F, with IP-55 protection. Motors shall be especially designed for quiet operation. Drive to fan shall be provided through direct-drive arrangement.
8. Fan
Fans shall be direct driven plug fan with aerofoil design blades, Direct Driven Fan with three phase motor so as to give maximum efficiency for given duty condition. The performance of the **direct driven Plug fan will be certified by a reputed 3rd party internationally acclaimed certifying body like AMCA**, and the entire Fan + Motor assembly will be balanced at supplier's works before despatch. Fans driven by variable frequency drive shall be backward inclined irrespective of static pressure value. Fans shall be selected for minimum efficiency of 70% & shall be made up of Composite material. **Plug fans shall have VFDs** Fan motor

assembly shall be statically and dynamically balanced to G6.3 grade as per relevant ISO/AMCA standard.

Motors shall be mounted inside the AHU casing on rigid frame/ slide rails for alignment, and be totally enclosed, fan cooled, to be class 'F' insulation.

Heavy duty anti-vibration mounts shall be provided for isolating the unit casing. Fire retardant, waterproof silicone rubber impregnated flexible connection shall be provided at the fan inlet/ discharge.

9. Cooling/Heating Coils

9.1 Chilled Water Cooling/Heat Coil

Chilled water coils shall have 12.5mm (1/2") dia. tubes minimum 0.5 mm thick with aluminium fins firmly bonded to copper tubes assembled in a zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg./Sq.cm air pressure under water. Tube shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Fins spacing shall be 11 to 13 fins per inch (4 to 5 fins per centimeter). Water pressure drop in coil should not exceed 10 PSI.

10. Filters

Shall be done as per specification given under Electronic Air Filter System.

11. Filter Assembly

Shall be done as per specification given under Electronic Air Filter System.

12. DDC Panel / Instrument kit.

DDC Controller module (Digital display HDMI) with RS 485 port compatible with BMS, on board protocol following

1. Plug fan operation status
2. Chilled water valve operation status
3. AHU Airflow (CFM) to monitor the fan status
4. AHU power consumption
5. Plug Fan On/Off status
6. Plug Fan parameters
7. ESP Filter Status
8. Controller shall also have fire trip alarm to shut AHU in case of signal from fire panel
9. UVGI Status

Instrumentation Kit to be provided to give out the following option

1. Supply air temperature sensor
2. Return air temperature Sensor
3. Chilled water in temperature
4. Chilled water out temperature
5. DP switch across filter for filter clog
6. CO2 measurement sensor in return air temp.
7. AHU Chilled Water Control
8. 2 way chilled water modulating control

13. Isolators

Vibration isolators shall be provided with all air handling units. The fan and motor framework shall be isolated from the AHU framework by means of spring type vibration isolators. The AHU shall be mounted on 8/9 nos. 200x200x200 P.C.C. blocks suitable for weight of the AHU. The framework of the AHU and the P.C.C. blocks shall be isolated by means of neoprene mats of size 150mmx150mm in two layers with 20g G.S.S. sheet sandwiched in between.

14. Accessories

Each air handling unit shall be complete with the accessories including but not restricted to the following.

- Insulated isolation valves, Y-strainer, header drain valves, unions and insulated condensate drain piping upto sump or floor drain in air handling unit room/ nearest point, as described in section "Piping of Schedule of items".
- Manual air vents at high points in the cooling coil and drain plug in the bottom of the coil. – to be included in the cost of the AHU.
- Thermometers in thermometer wells and pressure gauges in test points in chilled water supply and return lines. – to be included in the cost of the AHU. Air and Water side control as specified under section "Control and Instruments"

15. Painting

Powder coated paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop-painted surfaces.

16. Noise Control

Air Handling Units shall be selected for the lowest operating noise level of the equipment. Fan performance rating, power consumption, and sound power data with operating points clearly indicated shall be submitted with the tenders and verified at the time of testing and commissioning of the installation. The sound level of the AHU shall be less than 60 dBA at one meter distance at room condition.

17. Connections

Piping installation requirements are specified in other section. The Drawings indicate the general arrangement of piping, valves, fittings, and specialities. The following are specific connection requirements:

- Arrange piping installations adjacent to units to allow unit servicing and maintenance.
- Connect piping to air-handling units with flanges enabling easy removal of the coil.
- Connect condensate drain pans using 50 mm (2-0 inch) minimum, insulated G.I. pipe and extend to nearest floor drain. Construct deep trap (depth as per detail) at connection to drain pan and install cleanouts at changes in direction.
- Duct installations and connections are specified in other sections. make final duct connections with flexible connections.
- Electrical Connections: The following requirements apply:
 - Electrical power wiring is specified in section Electrical.
 - Temperature control wiring and interlock wiring is specified in Section "Electrical Control systems."
- Grounding: Connect unit components to ground in accordance with the Indian Electrical Code.

18. Adjusting, Cleaning, And Protecting

- Adjust water coil flow, with control valves to full coil flow, to indicate l/s (gpm).
- Adjust damper linkages for proper damper operation.
- Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.

19. Commissioning

- Final Checks Before Start-Up: Perform the following operations and checks before start-up:
 - Remove shipping, blocking and bracing.
 - Verify unit is secure on mounting and supporting devices, connections for piping, ductwork and electrical are complete. Verify proper overload protection is installed in motors, starters, and disconnects.
 - Perform cleaning and adjusting specified in this Section.
 - Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operations. Reconnect fan drive system and align belts.
 - Lubricate bearings, pulleys, belts, and other moving parts with factory recommended lubricants.
- Set outside-air / supply air dampers to minimum outside-air setting.

- Comb coil fins for parallel orientation.
- Install temporary throw away filters for initial run and finally install clean filters.
- Verify manual and automatic volume control, and fire dampers in connected ductwork system are in the full-open position.
- Disable automatic temperature control operators.
- Starting procedures for central-station air-handling units:
- Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicate RPM.
- Replace fan and motor pulleys as required to achieve design conditions.
- Measure and record motor electrical values for voltage and amperage.
- Shut unit down and reconnect automatic temperature control operators.

20. Testing

Cooling capacity of various Air handling units shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by a calibrated rotating vane anemometer and temperature measurements by accurately calibrated mercury-in-glass thermometers. Computed ratings shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current, whereas, noise level at various locations within the conditioned spaces shall be measured by a sound pressure level meter.

Note: - **Out Door Type:** AHU placed in open to atmosphere space (On terrace) shall have canopy of same material of AHU casing and thickness. Canopy size to be selected in such a way that entire AHU to be protected from rain and sun light.

N. HORIZONTAL /VERTICAL FLOOR MOUNTED AIR HANDLING UNITS (Critical Area)

1. SCOPE
The Scope of this section comprises the supply, erection, testing and commissioning of air handling units conforming to these Specifications and in accordance with requirements.
2. TYPE
The air handling units shall be double skin modular, draw through type comprising of various sections such as mixing chamber (wherever R .AIR and F.AIR are ducted.), pre filter section, chilled water coil section, fan section supply air plenum as per details given in Drawings and design requirement.
3. CAPACITY
The air handling capacities, maximum motor HP, static pressure shall be as shown on Drawings and as per design requirement'.
4. CASING
AHU for Critical Areas –ICU, OTs, Sterile Corridor, Labs, CSSD, Radiology

Double skinned panels shall be 40+/-2 mm thick Double Skin Panels with thermal break profile, shall be made of 0.8mm Pre-coated GSS on outside and 1.0mm Aluminium sheet inside with CFC – FREE P.U. insulation of 42 (+/- 5%) kg/Cu M injected in between with an internal gasket between the skins to interrupt the thermal bridge of the panel. Outer sheet of panels shall be made of galvanized pre-coated sheet of 0.8 mm thickness **to ensure mechanical strength as per class D1 of EN 1886, air leakage as per class L1 of EN 1886, thermal bridging of minimum TB2 class and thermal transmittance of minimum T2 class as per EN 1886 and filter bypass class F9 of EN 1886.**

The entire framework shall be mounted on an aluminium alloy or galvanized steel or heavy duty engineering composite material (depending on size) channel base as per manufacturer's recommendation. Panels shall be assembled together to form an enclosure that is capable of low air leakage potential, conforming to class A of EN 1886:2007. Handles shall be made of hard nylon and all access panels should be openable with Allen key arrangement. Units supplied with various sections shall be suitable for onsite assembly with continuous foam gasket. All fixing and gaskets shall be concealed.
5. Mixing Box
AHU's requiring mixing boxes as specified in drawings shall be complete with fresh and return air dampers.
6. Damper
Dampers shall be opposed blade type. Blades shall be made of double skinned aero foilaluminum sections with integral gasket and assembled within a rigid extruded aluminum alloy frame. All linkages and supporting spindles shall be made of aluminum or nylon, turning in teflon bushes. Manual dampers shall be provided with a bakelite knob for locking the damper blades in position. Linkages shall be extended wherever specified for motorized operation. Damper frames shall be sectionalized to minimize blade warping. Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure.
7. Motor and Drive
Fan motors shall be energy efficient (IE-3) and shall be 415±10% volts, 50 cycles, three phase, totally enclosed fan-cooled class F, with IP-55 protection. Motors shall be especially designed for quiet operation. Drive to fan shall be provided through direct-drive arrangement.
8. Fan
Fans shall be direct driven plug fan with aerofoil design blades, Direct Driven Fan with three phase motor so as to give maximum efficiency for given duty condition. **All direct driven Plug fan with casing will be certified by a reputed 3rd party internationally acclaimed certifying body like Eurovent or AMCA,** and the entire Fan + Motor assembly will be balanced at supplier's works before despatch. Fans driven by variable frequency drive shall be backward inclined irrespective of static pressure value. Fans shall be selected for minimum efficiency of 70% & shall be made up of Composite material. **Fan array with multiple fans should be used for capacities more than 17000 CMH. Plug fans in fan array shall have individual VFDs for every motor fan set.** Fan motor assembly shall be statically and dynamically balanced to G6.3 grade as per relevant ISO/AMCA standard. **Certified Computerized selection for AHU shall be with fan selection and sound level spectrum. Complete AHU sound level should be given in computerized selection sheet instead of sound level of bare fan.**

Motors shall be mounted inside the AHU casing on rigid frame/ slide rails for alignment, and be totally enclosed, fan cooled, to be class `F' insulation.

Heavy duty anti-vibration mounts shall be provided for isolating the unit casing. Fire retardant, waterproof silicone rubber impregnated flexible connection shall be provided at the fan inlet/ discharge.

Fans shall be direct driven plug fan with aerofoil design blades, Direct Driven Fan with three phase motor so as to give maximum efficiency for given duty condition. The performance of the **direct driven Plug fan will be certified by a reputed 3rd party internationally acclaimed certifying body like AMCA**, and the entire Fan + Motor assembly will be balanced at supplier's works before despatch. Fans driven by variable frequency drive shall be backward inclined irrespective of static pressure value. Fans shall be selected for minimum efficiency of 70% & shall be made up of Composite material. **Plug fans shall have VFDs** Fan motor assembly shall be statically and dynamically balanced to G6.3 grade as per relevant ISO/AMCA standard.

9. Cooling/Heating Coils

9.2 Chilled Water Cooling/Heat Coil

Chilled water coils shall have 12.5mm (1/2") dia. tubes minimum 0.5 mm thick with aluminium fins firmly bonded to copper tubes assembled in a zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg./Sq.cm air pressure under water. Tube shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Fins spacing shall be 11 to 13 fins per inch (4 to 5 fins per centimeter). Water pressure drop in coil should not exceed 10 PSI.

9.3 DX Cooling coil

Wherever low temperature (18 deg C) is required all those OT AHU's shall be provided with DX cooling coil section

Air Cooled DX condensing units complete with condenser coil, axial flow fan(s), first fill of refrigerant (R410a), hermetically sealed SCROLL compressor(s). All shall be concealed in sheet steel cabinet, all welded or bolted construction complete in all respects, in all respects. Condensing units will work with OT AHU. Outdoor unit motor should be with IP-55 protection and should be weather proof.

The Condensing unit shall be designed at 34.5 Deg C The unit capacities shall be after taking deration into account due to copper piping lengths. Power consumption of Condensing unit should not exceed 1.3 kW/TR. However, least power consumption will be preferred only.

Condensers should be adequately sized for high ambient temperatures upto 34.5 Deg C with condensing temperatures not exceeding 56 Deg C. Each refrigerant circuit should have an independent condenser with condenser.

Condensing unit suitable for 8.5 TR actual refrigeration Capacity # 1 No.

Dx cooling coil section with aluminium finned plain copper tubes (tubes thickness not less than 0.41mm & dia. 12.5mm) cooling coil. Tubes with aluminium fins firmly bonded to copper tubes assembled in a zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg./Sq.cm air pressure under water. Tube shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Water pressure drop in coil should not exceed 10 PSI.

10. Filters

Shall be done as per specification given under Electronic Air Filter System.

11. Filter Assembly

Shall be done as per specification given under Electronic Air Filter System.

12. AHUs shall be certified for Mechanical performance & Rating and performance for units/component and section as a whole as per following standards

- 12.1 For Mechanical performance as per EN 1886 : 2007/AHRI 1350/1351
- 12.2 Mechanical Strength of Casing_D1
- 12.3 Casing Air Leakage_L1
- 12.4 Filter Bypass Leakage_F9
- 12.5 Thermal Transmission_T2
- 12.6 Thermal Bridging_TB2
- 12.7 Acoustic insulation of Casing as per BSEN/ISO 25136
- 12.8 For Rating & Performance for Units, Components and Sections as per EN 13053: 2006 +A1: 2011

The real unit shall be tested at the certified laboratory for following parameter.

- 12.9 Air flow: Static pressure data, power consumption.
- 12.10 Octave bands for conducted sound power emissions as per EN ISO 3741, 3744 & 3746
- 12.11 Heat recovery as per EN 308
- 12.12 Cooling Duty as per EN 1216
- 12.13 Heating Duty as per EN 1216
- 12.14 Air Side and Water side pressure drop
- 12.15 Filter performance as per EN 779 Aerodynamic testing of damper and valves as per EN 1751
- 12.16 Fluid flow as per EN ISO 5167-1
- 12.17 Fan performance as per ISO 5801

Note:

- 1. Above tested parameter and selected parameter should be strictly within the close tolerances set by the above mentioned standards.
- 2. All the technical selections should be from a certified selection software version that is enlisted on the third party Eurovent certifying body website. If a manufacturer submits separate selection sheets for different components, it means that the components are not included in the certification process. The complete AHU selection shall contain all components which should carry Eurovent logo on each page with the software version.
- 13. DDC Panel / Instrument kit.
DDC Controller module (Digital display HDMI) with RS 485 port compatible with BMS, on board protocol following
 - 1. Plug fan operation status
 - 2. Chilled water valve operation status
 - 3. AHU Airflow (CFM) to monitor the fan status
 - 4. AHU power consumption
 - 5. Plug Fan On/Off status
 - 6. Plug Fan parameters
 - 7. Controller shall also have fire trip alarm to shut AHU in case of signal from fire panel
 - 8. UVGI StatusInstrumentation Kit to be provided to give out the following option
 - 1. Supply air temperature sensor
 - 2. Return air temperature & RH Sensor
 - 3. Chilled water in temperature
 - 4. Chilled water out temperature
 - 5. Hot water in temperature
 - 6. Hot water out temperature
 - 7. DP switch across filter for filter clog
 - 8. CO2 measurement sensor in return air temp.
 - 9. AHU Chilled Water Control
 - 10. 2 way chilled water modulating control
 - 11. 2 way hot water modulating control

- 14. Isolators

Vibration isolators shall be provided with all air handling units. The fan and motor framework shall be isolated from the AHU framework by means of spring type vibration isolators. The AHU shall be mounted on 8/9 nos. 200x200x200 P.C.C. blocks suitable for weight of the AHU. The framework of the AHU and the P.C.C. blocks shall be isolated by means of neoprene mats of size 150mmx150mm in two layers with 20g G.S.S. sheet sandwiched in between.

15. Accessories
Each air handling unit shall be complete with the accessories including but not restricted to the following.
 - Insulated isolation valves, Y-strainer, header drain valves, unions and insulated condensate drain piping upto sump or floor drain in air handling unit room/ nearest point, as described in section "Piping of Schedule of quantities".
 - Manual air vents at high points in the cooling coil and drain plug in the bottom of the coil. – to be included in the cost of the AHU.
 - Thermometers in thermometer wells and pressure gauges in test points in chilled water supply and return lines. – to be included in the cost of the AHU. Air and Water side control as specified under section "Control and Instruments"
16. Painting
Powder coated paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop-painted surfaces.
17. Noise Control
Air Handling Units shall be selected for the lowest operating noise level of the equipment. Fan performance rating, power consumption, and sound power data with operating points clearly indicated shall be submitted with the tenders and verified at the time of testing and commissioning of the installation. The sound level of the AHU shall be less than 60 dBA at one meter distance at room condition.
18. Connections
Piping installation requirements are specified in other section. The Drawings indicate the general arrangement of piping, valves, fittings, and specialities. The following are specific connection requirements:
 - Arrange piping installations adjacent to units to allow unit servicing and maintenance.
 - Connect piping to air-handling units with flanges enabling easy removal of the coil.
 - Connect condensate drain pans using 50 mm (2-0 inch) minimum, insulated G.I. pipe and extend to nearest floor drain. Construct deep trap (depth as per detail) at connection to drain pan and install cleanouts at changes in direction.
 - Duct installations and connections are specified in other sections. make final duct connections with flexible connections.
 - Electrical Connections: The following requirements apply:
 - Electrical power wiring is specified in section Electrical.
 - Temperature control wiring and interlock wiring is specified in Section "Electrical Control systems."
 - Grounding: Connect unit components to ground in accordance with the Indian Electrical Code.
19. Adjusting, Cleaning, And Protecting
 - Adjust water coil flow, with control valves to full coil flow, to indicate l/s (gpm).
 - Adjust damper linkages for proper damper operation.
 - Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.
20. Commissioning
 - Final Checks Before Start-Up: Perform the following operations and checks before start-up:
 - Remove shipping, blocking and bracing.
 - Verify unit is secure on mounting and supporting devices, connections for piping, ductwork and electrical are complete. Verify proper overload protection is installed in motors, starters, and disconnects.
 - Perform cleaning and adjusting specified in this Section.
 - Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operations. Reconnect fan drive system and align belts.

- Lubricate bearings, pulleys, belts, and other moving parts with factory recommended lubricants.
- Set outside-air / supply air dampers to minimum outside-air setting.
- Comb coil fins for parallel orientation.
- Install temporary throw away filters for initial run and finally install clean filters.
- Verify manual and automatic volume control, and fire dampers in connected ductwork system are in the full-open position.
- Disable automatic temperature control operators.
- Starting procedures for central-station air-handling units:
- Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicate RPM.
- Replace fan and motor pulleys as required to achieve design conditions.
- Measure and record motor electrical values for voltage and amperage.
- Shut unit down and reconnect automatic temperature control operators.

21. Testing

Cooling capacity of various Air handling units shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by a calibrated rotating vane anemometer and temperature measurements by accurately calibrated mercury-in-glass thermometers. Computed ratings shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current, whereas, noise level at various locations within the conditioned spaces shall be measured by a sound pressure level meter.

Note: - **Out Door Type:** AHU placed in open to atmosphere space (On terrace) shall have canopy of same material of AHU casing and thickness. Canopy size to be selected in such a way that entire AHU to be protected from rain and sun light.

O. HEAT RECOVERY VENTILLATION SECTION: (PLATE HEAT EXCHANGER TYPE)

SCOPE

Supply, Installation, testing and commissioning of factory fabricated double skin type Heat Recovery Units as per specifications given below.

Type

Floor mounted horizontal unit comprises modular sections like Pre-filter; Fan sections and plate type heat exchanger.

Capacity

Capacities of the Heat Recovery Units like air flow, cooling and heating recovery, and maximum allowable motor ratings are mentioned in the drawings, and as per design requirements.

A.1.1 HRU Construction

A HRU should have these basic constructions; a triple chamber load-bearing frame, internally rounded and infill panels with sandwich panels with thermal and acoustic insulation interposed, in anodized aluminium material with thermal break. Thickness of the aluminium profiles that make up the frame should not be less than 57mm and the connection between the elements should take place through corner pieces with interlocking joint and screw fixing.

HRU casing should be made of 40mm thick sandwich panels fixed to the frame with exclusive locking profile and complete absence of screw. Panel shall be made from minimum 0.8 mm pre-painted galvanised steel sheet outside casing & minimum 0.8 mm stainless steel or anti-bacterial painted for inside casing, internal frame, and bottom. It should have minimum 40 mm thick expanded polyurethane insulation factory injected between them by injection moulding m/c, with density not less than 45 kg/m³ between them. Bearing frame should be rounded Aluminium profiles with corners made of reinforced nylon. The frame should be Aluminium anodised with thermal brake profile. Base frame should not be less than 120mm. The HRU will be equipped with drainage bottom panels to allow an effective discharge of the washing residue of the internal components; the surface of the panel shall be shaped like a diamond point with the central drain fitted with a drain. (The minimum slope for drainage is 3%).

The doors can be opened with rotation on hinges and closed by self-tightening handles and sealing elements recessed along the entire perimeter. In the case of fan sections, the removable panels are fixed by means of handles with 2-step safety opening. In the case of sections under pressure, the removable panels are fixed by means of screwed knobs

The unit should be equipped with CE marking which certifies compliance with the safety requirements of the directives applicable to it and the manufacturing company should have ISO 9001 - ISO 14001 certification.

A.1.2 Filter section

ESP filter (Refer filter section)

A.1.3 Doors and Empty Section

Heat Recovery Unit should have proper doors in-between two sections, and it should easy accessibilities for a human to inspect and service (Minimum 450mm width). An empty section should provide if there is no space available in any section of the Heat Recovery Unit. A view port and in-built LED light along with switch wired in factory should be provided with Heat Recovery Units. Limit switches should be provided compulsory with all the doors of the Heat Recovery Units to protect the HRU from any kind of accident.

The doors can be opened with rotation on hinges and closed by self-tightening handles and sealing elements recessed along the entire perimeter.

In the case of fan sections, the removable panels are fixed by means of handles with 2-step safety opening. In the case of sections under pressure, the removable panels are fixed by means of screwed knobs

A.1.4 Fan and Motors:

Fans shall be direct driven plug fan with aerofoil design blades, Direct Driven Fan with three phase motor so as to give maximum efficiency for given duty condition. The performance of the **direct driven Plug fan will be certified by a reputed 3rd party internationally acclaimed certifying body like AMCA**, and the entire Fan + Motor assembly will be balanced at supplier's works before despatch. Fans driven by variable frequency drive shall be backward inclined irrespective of static pressure value. Fans shall be selected for minimum efficiency of 70% & shall be made up of Composite material. **Plug fans shall have VFDs** Fan motor assembly shall be statically and dynamically balanced to G6.3 grade as per relevant ISO/AMCA standard.

Motors shall be mounted inside the AHU casing on rigid frame/ slide rails for alignment, and be totally enclosed, fan cooled, to be class `F' insulation.

Heavy duty anti-vibration mounts shall be provided for isolating the unit casing. Fire retardant, waterproof silicone rubber impregnated flexible connection shall be provided at the fan inlet/ discharge.

A.1.5 Diffuser Section

A diffuser section should be provided after fan section to maintain a laminar flow in the HRU supply side opening.

A.1.6 Accessories

- LED light with factory fitted cable and switch on outside HRU wall.
- View port and door should provide after each section of the unit.
- Cable gland should provide in fan sections by manufacturer (to protect further leakage) in fan sections.

A.1.7 Sound level

All HRUs should be very low noise type and have overall sound pressure level 60dB (A) at the distance of 1m from the unit.

A.2.0 Testing

Cooling and heating recovery capacities of various heat recovery models shall be computed from the measurement of air flow; dry and wet bulb temperature of air entering and leaving the plate type exchanger.

A.2.3 Performance Data

Heat Recovery Units shall be selected with its lowest noise level and comply all the basic. All fans should be selected at their highest efficiency class. Fan performance chart along with all selected data must be submitted and checked at the time of testing and commissioning.

A.2.4 Data / Selection

All Heat Recovery Units should be selected via computerised selection software and software should have third party certification to ensure correct technicalities.

Sr. No.		
1	General	
2	Manufacturer	
3	Manufacturing Country	
4	Certification details	

5	Overall dimensions	
6	Overall weights	
7	Overall Noise Pressure level (dB-A) at 1m distance	
8	Fan Type and number of fans	
9	Motor type and efficiency class	
10	Fan Diameter in mm	
11	Fan Total efficiency	
12	Motor BKW	
13	Motor Rating	
14	Selected fan – Motor frequency at Hz	
15	HRU fan ESP	
16	Plate Type exchanger Capacity (KW)	
17	Plate Type exchanger material	
18	Plate Type exchanger Latent Efficiency	
19	Plate Type exchanger Sensible Efficiency	
20	Plate Type exchanger Pressure drop	
21	Air In-Out temp in Supply Side	
22	Air In-Out temp in Return Side	
23	ESP filter class and filter length	

Note: - **Out Door Type:** HRU placed in open to atmosphere space (On terrace) shall have canopy of same material of HRU casing and thickness. Canopy size to be selected in such a way that entire HRU to be protected from rain and sun light.

P. HEAT RECOVERY VENTILLATION SECTION: (ENTHALPY WHEEL)

- a. Wheel: The wheel shall be made of alternate layer of corrugated and intervening flat composite material of aluminium foil of uniform width to ensure smooth surface. The wheel medium should be bonded together to form rigid transfer medium forming a multitude of narrow channels ensuring laminar flow. The wheels shall be of proven design. The wheel can be fully wound or on larger units, sectorised, i.e. assembled in segments. In latter case the segments are assembled between rigid spokes thus ensuring structural longevity and allowing replacement of one or specific segments only. The wheel shall be cleanable by spraying its face surface with compressed air, low temperature steam or hot water or by vacuum cleaning without affecting its latent properties.
- The face velocity across the wheel should not exceed 700 fpm (3.5 m/s).
The wheels shall be tested in accordance with ASHRAE S4-78 method of testing air to air heat exchangers. Development an manufacturers shall meet all quality assurance criteria specified in BSEN ISO 9001.
The minimum sensible and latent efficiencies should be 75%. A computerized selection should be enclosed along with offer.
- b. Casing: The casing shall be constructed as a single skin, self-supporting, galvanized sheet steel structure and include rotary wheel support beams and purging sector. The casing shall be supplied with access panels to facilitate inspection and service. Size 2150 mm and larger shall be in two sections to facilitate shipping and handling.
- c. Seals: The casing shall be equipped with adjustable brush seals, which minimize the carryover to max 0.05 – 0.2%.
- d. Hub and Spokes: Hub and Spokes on one piece rotor shall be Aluminum and on sectorized rotor Hub shall be made of steel, painted with anti-corrosion paint and galvanized sheet steel spokes.
- e. Drive: The wheel shall be belt driven along its perimeter. A constant speed fractional horsepower motor shall be used. The motor shall be mounted on a self-adjusting base to provide correct belt tension.

TESTING

The Thermal Wheel shall be tested in accordance with the parameters fixed as below.

- Supply Air Capacity - FDB/FWB.
- Exhaust Air Capacity - FDB / FWB.
- Fresh Air Capacity - FDB / FWB

Heat exchanger units(HRV) in double skin construction, constructed out of extruded Aluminium section frame with puf insulated panels,blowers,IE-3 Motor plate to plate type Aluminium heat exchanger and filters. The unit will have two separate passages one for supply of fresh air and the other for exhaust of cool air from the rooms after the revovery of energy. Efficiency of these heat exchangers shall be 60-65%.The plate to plate heat exchanger shall be rigid thermally bonded seamless Aluminium channels separated by extruded aluminium spacers of the following capacity.

Q. VARIABLE FREQUENCY DRIVES FOR HVAC SYSTEMS (For Cooling Tower & AHUs)

General Requirement

- This specification covers complete variable frequency drives (VFD's).
- The frequency converter shall not be a general purpose product, but a dedicated HVAC engineered product.
- The VFD and its options shall be factory mounted and tested as a single unit under full load before dispatch.
- **The VSD module shall be tested to UL 61800-5-1. The appropriate UL label shall be applied.**
- The VFD shall be CE marked and conform to the European Union Electro Magnetic Compatibility directive
- The VFD shall be UL listed for a short circuit current rating of 100 kA and labeled with this rating.

Technical Requirement

The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor derating. When properly sized, the VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. VFD's utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

Power Factor

The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor.

The VFD shall be with active front end technology i.e IGBT based Inverter & IGBT based converter with inbuilt LCL filter meeting THDi guideline of less than 5% at nominal load, as per IEEE 519 standard at drive input without external additional harmonic filter for ratings 4kW and above.

EMC Filter

All VFD's shall contain integral EMC Filters to attenuate Radio Frequency Interference conducted to the AC power line. The VFD's shall comply with the emission and immunity requirements of IEC 61800-3: 2004, Category C2 with 100m motor cable (unrestricted distribution). The suppliers of VFD's shall include additional EMC filters if required to meet compliance to this requirement.

Integrated hardware features

- Built-in Safe Torque off (STO) feature as standard for safety related applications up to SIL 3, SILCL 3 and PL e.
- Provision to Commission & monitor drives wirelessly with Optional Bluetooth assistant control panel
- Built-in Real time clock
- USB interface for PC and tool connection, freely downloadable drive composer PC tool
- Conformal Coated boards for harsh environments
- Optional remote monitoring with additional hardware possible.

The VFD's full load output current rating shall meet or exceed the normal rated currents of standard IEC induction motors. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 second while starting. The VFD shall provide full motor torque at any selected frequency from 20 Hz to base speed while providing a variable torque V/Hz output at reduced speed. This is to allow driving direct drive fans without high-speed derating or low speed excessive magnetization, as would occur if a constant torque V/Hz curve was used at reduced speeds. Breakaway current of 160% shall be available. A programmable automatic energy optimization selection feature shall be provided as standard in the VFD. This feature shall automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings – AEO is part of VFD. The VFD must be able to produce full torque at low speed to operate direct driven fans.

Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.

An Automatic Motor Adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or decouple the motor from the load to perform the test – AMA is part of VFD. Galvanic isolation shall be provided between the VFDs power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFD's not including either galvanic or optical isolation on both analog I/O and discrete digital I/O shall include. **The terminals on the control unit shall comply with PELV (Protective extra low voltage) requirements as per EN 50178.** VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFD's with fixed carrier frequency are not acceptable. The VFD shall allow up to at least 100 meters of SWA (Single wire armored) cable to be used between the FC and the motor and allow the use of MICS (Mineral Insulated Copper Sheath) cable in the motor circuit for fire locations.

Motor control

- Supports of Induction Motors, PM Motors, IE3 motors
- V/Hz, Sensor less and Flux Vector Control.
- Maximum Frequency Programmable up to 500 Hz
- Switching frequency from 1 KHz to 12 KHz

Protective Features

- A minimum of Class 20 I2t electronic motor overload protection for single motor applications shall be provided. Overload protection shall automatically compensate for changes in motor speed **and should ensure protection as per IEC 60947-4-1. The VFD should have built in overload function with thermal memory retention and speed sensitivity. The VFD should have settable motor thermal overload trip classes of 5, 10, 20, 30, 40.**
- Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable

- Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost
- Protect from under voltage. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. **The VFD will continue to operate with reduced output, without faulting, with an input voltage range 380 V to 480 V , -15% to +10%**
- VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost
- If the temperature of the VFD s heat sink rises to 80 C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. It shall also be possible to program the VFD so that it reduces its output current limit value if the VFD s temperature becomes too high
- In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.
- The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.
- Protect from output switching: The VFD shall be fully protected from switching a contactor / isolator at the output without causing tripping e.g.: for switching on/off the isolators of the AHU / ventilation fans / pumps near the motor with VFD in ON mode
- When used with a pumping system, the VFD shall be able to detect no-flow situations, dry pump conditions, and operation off the end of the pump curve. It shall be programmable to take appropriate protective action when one of the above situations is detected.

Interface Features

- Hand off and Auto keys shall be provided on the control panel to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation
- There shall be an Info key on the keypad. The Info key shall include online context sensitive assistance for programming and trouble shooting.
- The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.
- Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes.
- The VFD display for be capable of taking screenshots for instantaneous events with alphanumeric Graphical display

- Drive shall be provided with Bluetooth enabled Control Panel for wireless interface with mobile phones / PDA
- All VFD's shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFD
- To set up multiple VFD's, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFD's in turn and download the setup parameters to each VFD. To facilitate setting up VFD's of various sizes, it shall be possible to download from the keypad only size independent parameters. Keypad shall provide visual indication of copy Status.
- Display shall be programmable to communicate in multiple languages including English.
- A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD. The VFD shall also have individual Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications
- A two-feedback PID controller to control the speed of the VFD shall be standard.
- This controller shall accept up to two feedback signals. It shall be programmable to compare the feedback signals to a common set point or to individual set points and to automatically select either the maximum or minimum deviating signal as the controlling signal. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals
- The VFD shall be able to apply individual scaling to each feedback signal.
- The VFDs PID controller shall be able to actively adjust its set point based on flow. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system
- Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
- Five simultaneous meter displays shall be available. They shall be selectable from (at a minimum), frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, feedback signals in their own units, among others
- Programmable Sleep Mode shall be able to stop the VFD. When its output frequency drops below set sleep level for a specified time, when an external contact commands that the VFD go into Sleep Mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop. When the VFD s speed is being controlled by its PID controller, it shall be possible to program a wake-up feedback value that will cause the VFD to start. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD
- A run permissive circuit shall be provided to accept a system ready signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of initiating an output run request signal to indicate to the external equipment that the VFD has received a request to run
- VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F). Examples can be

room temperature in 0C, return air temperature in 0C, supply air temperature in 0C, CO2 concentration in ppm, pressure in bar, differential pressure in PSI etc

- VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication

Standard Control and Monitoring Inputs and Outputs

- **Six dedicated**, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry
- **Three programmable** relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status
- Each relay shall have an adjustable on delay / off delay time
- Two programmable analogue inputs shall be provided that can be either direct-or-reverse acting
- Each shall be independently selectable to be used with either an analog voltage or current signal
- The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA
- A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise
- The Analog input terminals shall be of 12-bit resolution for improved accuracy.
- The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and trouble shooting
- **Two programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status.** This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.
- It shall be possible to command all digital and analog output through the serial communication bus.

Optional Control and Monitoring Inputs and Outputs

- It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.
- These modules shall use rigid connectors to plug into the VFD s control card.
- The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module
- Modules may include such items as:
 - Additional digital outputs, including relay outputs
 - Additional digital inputs
 - Additional analog outputs

- Additional analog inputs, Drives should be suitable for accepting motor thermal sensors like Pt 100, Pt 1000, Ni 1000, Kty 83 & Kty 84 sensor inputs. Optionally should have provision to connect ATEX certified PTC interface

- It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.
- Standard programmable fire-fighters override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display FIREMODE whenever in fire-fighters override mode. Fire mode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.
- A real-time clock shall be an integral part of the VFD. **Real time clock shall be part of drive display. VFDs with Real time clock as part of drive control circuitry or optional card is not acceptable.**
- It shall be possible to use this to display the current date and time on the VFD's display
- Ten programmable time periods, with individually selectable ON and OFF functions shall be available. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter set points and output relays. It shall be possible to program unique events that occur only during normal work days, others that occur only on non-work days and others that occur on specific days or dates. The manufacturer shall provide free PC based software to set up the calendar for this schedule.
- All VFD faults shall be time stamped to aid troubleshooting
- It shall be possible to program maintenance reminders based on date and time, VFD running hours, or VFD operating hours.
- The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log
- The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time
- The VFD shall include a sequential logic controller to provide advanced control interface capabilities. This shall include:
 - Comparators for comparing VFD analog values to programmed trigger values
 - Logic operators to combine up to three logic expressions using Boolean algebra
 - Delay timers
 - A 20-step programmable structure
- The VFD shall include a Cascade Controller which allows the VFD to Operate in closed loop set point (PID) control mode one motor at a controlled speed and control the operation of 3 additional constant speed motor starters

Serial Communications

The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:

Bacnet MSTP

Modbus RTU

VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD as a part of VFD display. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. **It shall be possible to communicate to the VFD through this USB port without removal of display from VFD module or interrupting VFD communications to the building management system.**

The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFDs control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

Adjustments

The VFD shall have a manually adjustable carrier frequency to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.

Four independent setups shall be provided. Four preset speeds per setup shall be provided for a total of 16. Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from **1 to 1,800 seconds**. Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload. The number of restart attempts shall be selectable from **0 through 5** and the time between attempts shall be adjustable from 0 through 600 seconds. An automatic start delay may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.

Three programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

Service conditions

- Ambient temperature at full speed, full load operation with continuous drive rated output current: -10°C to 40°C without derating for all rating
- Relative Humidity: 0 to 95%, non-condensing
- Elevation: Up to 3,300 feet without derating
- AC line voltage variation: + 10% of nominal with full output.
- **VFD Enclosure protection:**
IP55 depending.
Side Clearances: No side clearance shall be required for cooling
- All power and control wiring shall be done from the botto

R. FILTERS

1.0 General

This section covers the general requirements for special type of filters to be installed in air moving equipment or air ducts.

2.0 Electronic Air Filter

It is the intent of the specification to incorporate highly efficient electronic air filtration system with low pressure drops into the building AHU/TFA/Heat Recovery Units (HRU).

All AHU's/TFA/Heat Recovery Units shall be fitted with a true electronic air cleaner system (complete with washable pre-filter, charging section and collector section) to be installed before the cooling coils. Other forms of air filtration systems such as charged media filters, dielectric media filters, or ionizers (which do not have second stage collector plates) shall not be acceptable. The electronic air cleaner (EAC) shall be capable of removing particulates as small as 0.01 microns including microscopic haze particles, smoke, dust, mould spores and bacteria.

Central Air Cleaner, a hybrid air purification system, should improve the indoor air quality by reducing harmful pollutants like particulate matter (PM_x), PM 2.5, allergens, pollen, smoke, bacteria, pathogens based on Electrostatic precipitation technology. Other forms of air filtration systems such as charged media filters, dielectric media filters, or ionizers (which do not have second stage collector plates) shall not be acceptable. It should be a monobloc structured unit specifically designed for integration in Return Air path of the AHU, to centrally capture the pollutants. It should be equivalent to MERV14 efficiency @ 1708 cfm with low pressure drop of not more than 65Pa @ 492fpm (certification for the same to be provided). It should be UL certified within built provision to connect to BMS. The product has to be certified as a green product by any of the Green Building councils across the world.. The central air cleaner units must have a valid ANSI/ASHRAE 52.2 test report to verify filtration efficiency. The unit must have factory test report to ensure that it meets the following safety and environmental criteria with reference to ES164468, UL 867 and DA 6.2.1. Ozone level of units provided must be within the acceptable limit of 0.05ppm. The units shall have local LEDs at each individual unit to indicate when the units are up for wash/malfunctioning.

Approvals / Code Requirements

The EAC shall be Underwriter Laboratories (UL) Listed. The EAC shall also be EMC (Electromagnetic compatibility) certified. Full documentation must be submitted to confirm compliance to the above requirements.

Ozone level of EACs provided must be within the acceptable limit of 0.05ppm. Tenderers must also provide a test report to confirm conformance.

Factory Safety Test Report

The EAC must have factory test report to ensure that it meets the following safety and environmental criteria with reference to ES164468, UL 867 and DA 6.2.1:

Performance Testing

- Dielectric test
- Ambient and voltage extremes
- E-field test
- Oscillatory transient test
- Lightning test
- EFT (fast transients) test
- ESD (high voltage transients) test
- EMI susceptibility test
- EMI radiation test

Environmental

- Humidity
- Condensation
- Vibration

All tenderers must submit a design analysis conditional qualification test report to confirm that tests have been conducted based on the above criteria and that the EAC has passed these tests.

Safety Provisions

Each EAC cell shall have their automatic interlock switch which disconnects power and discharges the cell when the access door is opened. In addition, the EAC shall be capable of interlocking when disconnecting the power to each individual EAC unit, or when the AHU fan is not running.

A high voltage test button shall be provided for each individual high tension power supply unit to indicate the presence of high voltage on the electronic cells. An overall test button for a group of power supply units to provide a general indication of high tension voltage is not approved.

Performance / Reliability Requirements

The average capacity of the EAC shall be at least 1000cfm for the single cell unit and 2000cfm for the double cells unit.

The initial atmospheric dust spot efficiency (ASHRAE 52-76) of the EAC shall be at least 67% at 2000cfm and up to 95% at 800cfm. The proposed equipment shall be capable of capturing sub-micron particulates/contaminants down to 0.3 microns. All tenderers shall submit test results of filtration efficiency by Air Filter Testing Laboratories for efficiency verification.

The solid state power supply shall provide dual voltage to the ionizer and collector section. The voltage to the ionizer shall be at least 8000V/6400V DC to create an intense electrostatic field to allow maximum transfer of electrical charge from the ionizing wires to air particles. The voltage to the collector shall be at least 4000V/6400V DC.

For the EAC to perform effectively against PM 2.5 pollutants, the EAC shall have a fractional efficiency test report from a third-party testing laboratory to confirm CME (Composite Minimum Efficiency) of the following:

<u>Particle Size</u>	<u>CME</u>
0.3 to 0.4 µm	68%
1.0 to 1.3 µm	89%
2.2 to 3.0 µm	94%

The entire Filtration system shall be washable and reusable without need for replacements. Electrostatic media filters that collect particles on disposable media pads shall not be acceptable.

The average initial pressure differential drop across the entire filtration system shall not exceed 65 pa at 2000cfm and 2.5 m/s airflow. The tungsten ionizing wires and aluminum collector plates shall be integrated within one pack. It shall be washable for repeated use. A washable aluminium mesh prefilter shall be provided at the inlet to trap all larger sized particles.

Filter cells shall be universal to allow for a single inventory of filters as spare parts.

The EAC shall be completed with Hot- dipped Galvanized cabinet to protect against rust, heavy duty commercial used electronic cells, solid state power supply, protective screen and prefilter. A washable aluminium mesh prefilter shall be provided at the inlet to trap all larger sized particles.

The EAC shall have the capability for the optional addition of activated carbon (Charcoal) filter for the removal of gaseous contaminants and odours. The activated carbon filter shall be able to reside into the EAC cabinet as and when necessary; no modification for the initial installation shall be allowed.

Diagnostics / Interfacing to Building Management System

The EAC shall have the capability of interface with the building management system through a Solid State Performance Indicator (SSPI). The following status shall be allowed for remote monitoring by the building management system as common fault:

1. Normal operation of solid state power supply (ON)
2. Any malfunction of the system that shall cause an alarm activation (CHECK)
3. Excessive dirt accumulation in the collector cells that could result in the reduction of the EAC performance (WASH)

The EAC shall have local LEDs at each individual unit to indicate the above status and it shall be able to provide in addition a signal to link-up with the building management system for monitoring.

Submission of Compliance Documentation

Tenderers must submit a Clause-by-Clause Compliance Summary and provide full documentation/ technical literature/data sheets/reports to confirm compliance for each clause. Please also submit a project reference list.

3.0 High Efficiency Particulate Absolute (HEPA) Filters

HEPA filters shall be made in extended surface configuration of deep space folds of sub micron glass fibers. The filter media shall be housed in an aluminium sheet frame provided with double turned flanges and closed cell neoprene gasket. The filter media shall not absorb moisture, stretch, swell or undergo chemical change with moisture. The filter shall be resistant to fungus and bacterial growth. Filters shall be free from pin holes and other leaks.

The housing shall be designed to install the HEPA filters in the terminal locations in the false ceiling or in the duct plenum so that it is removed easily without risking the infiltration of dust whatsoever. The arrangement for filters shall be strictly in accordance with the manufacturers recommendations and shall be approved by the Engineer-In-Charge prior to fabrication and installation. The filters shall be protected with aluminium slotted protective grille from the bottom in case of installation of filters in false ceiling air terminals. All MS parts shall be derusted and shall be epoxy painted. The aluminium grilles shall be made from 1.6 mm aluminium sheets with minimum clear area of 60 percent. The grilles shall be anodised stove enamel painted as approved by the Engineer-In-Charge.

4.0 LAMINAR FLOW HEPA TENT:

i. Introduction:

Diffusers are available for flush mounting in the ceiling. Suitable angle frames are also provided for the modular panel construction. The units are available in three standard sizes for top entry complete with opposed blade dampers.

ii. Description:

LFD laminar flow HEPA TENT are constructed from SS-304, perforated face with approx 50% perforation. The perforated front face is openable hinge type complete with key operated dampers from front.

iii. Features :

- Suitable for modular panel assemblies.
- Front Faced with opposed blade dampers.
- Pivoting type face plate for damper operation from front.
- Easy maintenance and cleaning.

iv. Finished Standard :

S. STEAM HUMIDIFIER (OT AHU only)

Supply, Installation, testing and commissioning of Immersed-resistances steam humidifier for ambient and AHU/duct using drinkable mains water, demineralized water or deionized water. Humidifier heats and boils the water in a stainless steel cylinder. The steam generated is hygienically pure (aseptic).

Main technical specs:

Rated steam production:	6	kg/h
Rated power input:	4.5	kW
Power supply:	3	VAC 1-phase / 3-phases
No. of steam outlets:	1	
Steam outlet diameter:	30	mm
Steam pressure	0-1500	Pa
Supply water connection 3/4" gas male		
Drain connection 40 mm		

Accessories for AHU installations:

- Steam lance made of AISI304 with fitting flange and condensate outlet; length 650mm
- Steam nozzle distributor

Unique selling points:

- Electric resistances made in titanium with low thermal resistance for fast response, stability of production and safety against overheating;
- Each element shall have 1 patented PTC to detect and protect against overheating (patented);
- Patented antifoam algorithm (AFS) to prevent irregular operation due to the formation of foam inside the cylinder;
- The steam generator shall also have twin sensing electrodes for detection of water foaming and high limit water level;
- Plug & play web server for monitoring and setting of unit from remote position;
- Management of wireless probes (up to 4) to avoid cables into the building. User-editable of probes weight;
- Graphic touch display 4.3"

Other essential selling points:

- Water level sensor for the precise control of the water level on the entire conductivity range 0...1500µS/cm, without any change or additional board;
- Humidifier shall be suitable for any type of water: tap, demineralized, deionized and softener ($\leq 1\mu\text{S/cm}$ heater Steam titanium is needed);
- User-editable configuration of the controller for the high-accuracy control of the humidity ($\pm 1\%rH$);
- Steam capacity shall be continuously controlled in the range 0..100% of the rated production;
- Humidifier shall have built-in power transformer, no needs of neutral line on power supply or additional external transformer;
- Over-temperature protection on boiler cap (klixon, UR020-UR080);
- Embedded conductivity meter for the automatic management of the dilution drains and subsequent fills according to the supply water quality;
- SSR's (solid-state relays) for precise modulation of the steam production by dosing the power fed to the water;
- Intelligent microprocessor controller with algorithm that automatically adapts operation to the water quality;
- 4 built-in relays for remote signaling of: alarm relay, unit status relay (steam production), unit on/off, fan blower relay;
- The type of electric signal shall be selectable via keyboard among: on/off (humidistat), 0...10 V, 2...10 V, 0...1 V, 0...20 mA, 4...20 mA and NTC (in case of temperature regulation);

- RS485 serial port ready to communicate on Modbus, Bacnet or CAREL protocol for supervisory system. Without any additional devices;
- Ethernet port ready to communicate on Modbus or Bacnet protocol for supervisory system. Without any additional devices;
- Possibility to connect the humidifier to a remote supervisory system;
- Start-up wizard for simple step-by-step machine configuration during first commissioning;
- Type of controller: control with 9 algorithms always available to the user: on/off, production proportional to an external demand, production proportional to an external demand with modulating limiting probe, built-in %rH regulator with ambient probe, built-in %rH regulator with ambient probe and modulating limiting probe, built-in %rH regulator with two ambient probes (average), built-in temperature (°C/°F) regulator with ambient probe, built-in temperature (°C/°F) regulator with two ambient probes (average), built-in temperature (°C/°F) regulator with ambient and modulating limiting probe;
- Master-slave capability to extend the capacity with automatic rotation of units;
- Integrated backup of the unit for applications that require continuous service and non-stop humidification;
- Maintenance backup to automatic start the second unit during the services;
- The built-in USB port can be used for easy software updates, log file and alarm history extraction. Copy and paste parameters between units;
- Boiler thermal coating to reduce the heat loss;
- Thermal shock feature, removing lime scale from the heating elements, extends the cleaning intervals and makes maintenance quicker;
- Boiler's water temperature probe (NTC);
- Pre-heating to keep the water warm in order to reduce the time to production (user-editable pre-heating set point);
- The humidifier shall limit the steam production based on a proportional hi-limit probe that is self-adjusting according to AHU/duct air flow;
- Metallic housing with cover removable to allow full front access for easy maintenance;
- Electrical section separated by a division wall and including the power circuitry and the control components, manufactured according to state-of-the-art norms;
- ON/OFF digital input for remote enabling;
- Touch Display to change the displayed value, edit the system parameters, reset the alarms;
- Display of the supply water conductivity;
- Selection of the units of measure (SI or Imperial);
- Automatic check of valve, pump, water level sensor, presence of supply water at the start-up;
- Automatic management of the lack of supply water with automatic restart when the water is available again;
- Automatic maintenance warning;
- Drain pump for full range of capacity (2...80 kg/h) that helps to remove debris;
- The boiler shall be automatically emptied in case of prolonged inactivity, with the inactivity time-out being user-editable;
- Models 2-13 kg/h: the boiler shall be made of AISI304 stainless steel, openable for maintenance; models 20-80 kg/h: the boiler shall be made of AISI304 stainless steel, with the lid and a bottom front inspection panel removable for easy servicing;
- Compliances: CE, ETL, TÜV PRODUCT SERVICE, EAC;
- %rH probe for duct min. IP40 (10 %rH ... 90 %rH)

T. ELCTRONICALLY COMMUTATED MOTOR BASED FAN COIL UNITS

1. Scope:

Section Includes: Fan coil units complete in accordance with the requirements of the Contract Documents.

Works includes but is not limited to the following:

Energy efficient; low noise (> NC 35 or lesser) version of following fan coil units: Ceiling concealed / Ducted / Wall / ceiling / floor standing decorative type, Cassette Type Fan Coils.

Water temp 7/12 deg C and for hot water 50/45 deg C

2. Material:

General: Fan coil realised with support structure in galvanised steel. It should have holes in the rear part of the appliance for wall mounting and should have condensate drip tray with non corrosive material. For the models without cabinet, the closing panel of the ventilation unit is mounted on the front. The feet (accessory) for the ducted units are made of galvanised steel sheet metal.

PROTECTIVE CABINET When FCU placed open in the room - Casing colour RAL9003 / Flow grids colour RAL7047 or as per the architecture layout approval. The casing should be made with galvanised steel sheet metal and painted with polyester powder to guarantee high resistance to rust and corrosion.

The feet (accessory) for the units with casing are made of plastic colour RAL9003.

3. Fan Unit:

Fan unit: Centrifugal Inverter motor fans with double wing suction blades developed in length to achieve high flow rates at low revs. The motor make should be as per manufacturer recommendation provided the type of motor should full fill the tender specifications.

Electric motor protected against overloads with start condenser always inserted, directly coupled to the fans and buffered using elastic mounts. Extractable and inspecting screw in low-noise plastic material. The fan-motor should handle minimum 8 mm ESP, if required.

4. Filter Section:

Removable filter made from regenerable materials and which can be washed.
Filtration class G4

5. Coil type:

Fan-coil should supply with a single three-rows (standard) with copper tubes and aluminum fins; the manifolds should fit with female plugs and air vent should located at the top. The connections should position on the left side of the coil but should reversible during installation.

6. Condensate drip tray:

There should two condensate drip trays: one for vertical installation and one for horizontal installation. Both basins are thermally insulated and have double drainage to the right and to the left. The unused drain must be sealed as per the site adjustment.

7. Coil Thickness should vary or equal to (> 8mm - 9.8mm <)

8. Control:

The control panel should be in the fan coil head and may be protected from tampering by locking the cover door with a screw. In units with the T-Touch electronic controller and the App application, by simply placing the smart device on the fan coil it should possible to set operating modes and weekly hour programming using the APP's graphic interface. It should also possible to access a wealth of additional information such as the alarms list, the closest Technical Service Centre etc.

Available for Android OS.

In versions where the control panel is an accessory, it can be installed on the fan coil or be wall-mounted. In wall-ceiling mounted versions the control panel (accessory) can only be installed on the wall.

The fan coils should have option to integrate with BMS.

9. Manufacturer:

The products or manufacturers listed here in are included for the purpose of establishing minimum quality standards. Products equal in quality or better than those specified will be considered.

- A. Submit coil pressure drop, manufacturer's specifications for fan coil units showing dimensions, capacities, ratings, performance characteristics include sound power level, gages and finishes of materials and installation instructions. Need to submit software selection with all details.
- B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, constructions details and field connection details. Shop drawings shall show coordination with all related work sections.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to Fan Coil units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

10. DATA/ INFORMATION:-

The contractor shall complete the Data Sheet & submit as a part of his technical submittal at appropriate stage.

DATA SHEET A

	GENERAL	
1.1	Manufacturer	
1.2	Type of Unit	
1.3	Over All Dimensions (L x W x H) (mm)	
1.4	Weight (Including Water in circulation) Kg.	
1.5	Approximate Noise Level (DBA)	
1.6	Fan Discharge Position	
2.0	FAN SECTION	
2.1	Air Quantity (CFM)	
2.2	Total Static Pressure (mm of WG)	
2.3	Fan Speed (RPM)	
2.4	Fan Diameter (INCH) and no. Of fans	
2.5	Balancing (Static and / or dynamic)	
2.6	BHP	
2.7	Motor HP, RPM, Make & Type	
3.0	COOLING COIL	
3.1	Coil Fin Material (Aluminum or copper)	
3.2	Tube Diameter (INCH) and material	
3.3	Water through coil (USGPM) and no. of circuits	
3.4	Fin Size (INCH)	
3.5	No of Fins / INCH	
3.6	Water velocity through Coil (FPS)	
3.7	Water Coil Pressure Drop (ft of WG)	
3.8	Outside Coil Surface (SQFT)	
3.9	Face Area (SQFT) of Coil	
3.10	Rows Deep	
3.11	Water Temperature IN & OUT (DEG F)	
3.12	Air In and Out DB& WB Temp (DEG F)	

U. EVAPORATIVE COOLING UNIT - DOUBLE SKIN (air washer)

1. Type

The evaporative cooling unit shall be double skin construction draw through type comprising of various sections such as filter section, humidifier section, supply air fan section, fine filter plenum, factory fabricated (wherever required) as per details given in Drawings and 'Schedule of Items.'

2. Capacity

The cooling capacities, motor HP, static pressure shall be as shown on Drawings and in 'Schedule of Items'.

3. Construction

I. Housing/Casing

The housing/casing of evaporative unit shall be of double skin construction. The framework shall be of extruded aluminum hollow sections. All the frame shall be assembled using pressure die cast aluminum joints to make a sturdy, strong and self – supporting framework for various sections.

25 mm thick double skin panel shall be made of 0.6 mm plasticized /pre coated PVC sheeted GSS on outside and 0.6mm galvanized sheet inside with PUF insulation injected in between. These panels shall be screwed on to the framework with soft rubber gasket fixed in built in groove of aluminum frame in between to make the joints airtight.

Framework for each section shall be joined together with soft rubber gasket in between to make the joints airtight. Suitable airtight access doors/panels with nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on extruded aluminium channel framework having pressure die cast aluminium joints.

II. Drain Pan

Drain pan shall be constructed of 18 G stainless steel (SS-304 Grade) with necessary both way slope to facilitate fast removal of drain water.

III. Motor Drive

Fan motors shall be suitable for 415(+/-) 10% volts, 50 Hz, 3 phase, squirrel cage, totally enclosed fan cooled with IP-55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement or directly coupled/driven. Belts shall be of oil resistant type. Motors shall be of efficiency class IE-3.

IV. Fan

The fan shall be backward curved, double inlet, double width type. The wheels and housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame and pillow block heavy-duty ball bearings. The fan shall be selected for a noise level less than 75DB (A). at a distance of 2 m.

The impeller & fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 9 m/sec. Fan housing with motor shall be mounted on a common extruded aluminium base mounted inside the housing on anti vibration mounts. The fan outlet shall be connected to casing with the help of double fire retardant fabric acting as a flexible connection for anti vibration.

V. Wet Deck Humidifier

Wet deck humidifier pads shall be of cellulose paper minimum 200 mm deep to provide at least 90% saturation efficiency at 2.5 MPS or less air face velocity. The cellulose paper pads shall be housed in a galvanized steel casing complete with water distribution header and interconnecting heavy duty flexible PVC/ GI pipes between pump and distribution header.

VI. Water Circulating Pumps

Water circulating pumps shall be vertical type. The suction portion shall be at the bottom with proper seal arrangement to directly pick up water from the stainless steel drain pan. The pump shall be suitable to operate at 415(+/-) 10%V, 50 Hz AC supply.

Necessary water bleeding arrangements shall be incorporated with separate drain connection provided in the stainless steel drain pan to bleed small percentage of total circulated water in order to ensure compulsory water change over during running of the system.

VII. Filters

Each unit shall be provided with a factory assembled filter section containing washable air filter having bonded expanded aluminium media with aluminium frame. Filter media and frame shall be rust proof and corrosion resistant. Filter face velocity shall not exceed 150 meter per minute. Filter shall fit so as to prevent by pass. Holding frames shall be provided for installing a number of filter cells in banks. These shall be held within the frames by sliding the cells between guiding channels.

VIII. Fresh Air Intakes

Anodized extruded aluminium construction (20 microns and above) fresh air intakes louvers with bird screen and extruded aluminium low leakage construction damper shall be provided for FA. Blades shall be made of extruded aluminium. Construction shall be rattle free. Fresh air fans and fresh air intakes shall be as per the requirement of 'Schedule of Quantities'.

IX. Safety Features

Each evaporative unit must have following safety features:-

- i. The fan access door shall be equipped with micro switch interlocked with fan motor to enable switching off the fan motor automatically in the event of door opening.
- ii. The access door shall further have wire mesh screen as an added safety feature bolted on to the unit frame.
- iii. All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

X. Performance Data

Evaporative cooling units shall be selected for optimum operating noise level. Fan performance rating and power consumption data with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the system.

XI. Testing

Performance of evaporative cooling unit shall be computed from the measurements of air flow and dry and wet bulb temperature of air entering and leaving the unit. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated electronic instrument. Computed result shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

V. KITCHEN EXHAUST SCRUBBER – DRY SCRUBBERS

1. SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of dry scrubbers comprising of electrostatic sections with auto wash module for use in kitchen exhaust/ grease / exhaust air treatment.

2. TYPE

The unit shall be CE certified and of the type as indicated on Drawings and identified in Schedule of Quantities.

3. CAPACITY

The air-moving capacity of unit shall be as shown on Drawings and in Schedule of Quantities.

4. Technical Parameters

The unit shall provide efficiency of 90% or better for single pass base on ASHRAE test method at flow rates of 800 – 1300 CFM per module (supported by sample test report by a US laboratory). Multiple units can be joined together for increased volume. The system shall be suitable to connect to fan section with average velocity of 500 FPM across air cleaner.

5. Equipment specifications

The unit shall be designed and constructed and supplied by a manufacturer specializing in the research, design and manufacture of products specified in this section with a minimum of three years of documented experience, and capable of issuing complete catalog data on the total product.

6. Unit Housing

Housing shall be 16-gauge zinc coated steel construction to protect against rust and corrosion. Each section shall include single door access, located one side of the unit. The access door shall be mounted on steel hinges and secured with adjustable, gasket sealed lever latches allowing for component access and removal. All doors shall be gasketed to prevent air and water leakage. Doors to charged high voltage components shall be equipped with electrical interlocks, for interconnection into the primary power supply, to prevent access when the components are energized. The housing shall be furnished completely assembled for ease of shipment and installation. Between each section, a permanent 1/8" thick gasket shall be installed to prevent leakage. The bottom drain pan under ESP section containing integral washing systems shall be pitched downward 1/4" per foot minimum toward a 3" NPT drain nipple.

7. Base construction:

The sections are to be mounted on a structural C-channel or floor mounting or ceiling suspension. Lifting lugs shall be incorporated in the base channel to allow for rigging, if ordered.

8. Finish

The external casing finish shall be a durable industrial grade semi-gloss baked-on epoxy ester, not less than 3 mil minimum thickness.

9. Cells Wash Module

The Cells Wash module shall incorporate mechanical filtration. The stationary filter from the direction of airflow will be a metal mesh filters with single, gasketed access doors. Wash manifolds and headers are supplied to wash the module during the normal wash cycle.

10. Electrostatic Precipitator Module:

The electronic air cleaner shall be the two-stage dual voltage plate type cells, rated at not less than 90% efficiency as per the ASHRAE test standards for dry particulate (supported by sample test report by a US laboratory). The collection cells shall be in Single Pass arrangement to provide for maximum collection efficiency.

11. Ionizing collection cell

Ionizing-Collecting cell(s) shall be of one-piece construction 14.23" inches deep in direction of airflow. All support framing, end plates and ionizer ground electrodes shall be 0.090 inch thick aluminum. Both repelling and collector plates shall be 0.020 inch thick aluminum, 9.125 inch deep in direction of airflow and rigidly retained in place with tubular spacers and tie rods. Spacing between plates shall be no less than 0.175 inch. Ionizing electrodes shall be 24 gauge stainless steel spiked design, ionization wires are not acceptable, rigidly supported both vertically and laterally. High voltage support insulators shall be of self-glazing Cordierite ceramic with all surfaces, including center hole, glazed to enhance dielectric strength and retard tracking. Insulators shall be mounted out of the airstream, to reduce contaminant buildup. All high voltage electrical connections within each tier of cells, shall be between cells and automatically made when cells are installed. All electrical connections between unit tiers and high voltage connections between power packs and cells shall be located on the access door end of the cabinet and manually connected for ease of service.

12. Power Supplies

Power supplies shall be 100% solid state, UL Listed. operate on 200 to 240 VAC, 50 HZ, 1 Phase input and provide a dual high voltage output of (+) 12 to 13 KVDC for the ionizer and (+) 6.0 to 6.5 KVDC for the collector. A regulated output of up to 5.5 MA shall be supplied to maintain the specified collection efficiency. Integrally mounted electrical interlocks shall be provided to prevent access to the high voltage components without first interrupting the primary input power. The power supply shall operate over a temperature range of -32 degrees F to 140 degrees F, be self-protecting and accommodate an LED light indicating the performance status of the ionizing/collecting cell. High voltage output leads shall be sealed and a bleed resistor incorporated to remove stored electrical charge where the power supply(s) are deenergized. Module of capacity above 3000 CFM shall be equipped with Pulse width modulating (PWM) to maintain the specified collection efficiency by maintaining a constant charge in the event of Low/High Voltage from source thus ensuring that the unit functionality is not affected with these voltage fluctuations. Power Consumption should not be more that 50 watts per ESP cell.

All power supply components shall be designed for ease of mounting and servicing. High voltage power cables shall be of one continuous length, splicing is not acceptable.

13. System Controls

Programmable Logic Controller (PLC) shall be housed in a NEMA-12 type enclosure. Controller shall be shipped for remote mounting and must be installed indoors or other means of weather protection provided if installed. Terminals shall be provided to interconnect the system fan and shall sequence the detergent wash, soak, rinse fan force dry and return to operation cycle. All sequence times shall be factory set. Control initiation shall be semiautomatic, push button initiated, or fully automatic by time clock, with semiautomatic push button override.

A remote mounted Sleep Mode Reset Switch (momentary contact push button type) shall be supplied to be installed at the kitchen hood location to re-energize the air cleaning system after the wash system has completed. The switch may optionally be installed on the panel of the ATS control enclosure.

14. Automatic Time Clock

The control cabinet shall be furnished with a factory installed and wired 7-day initiator clock with battery backup.

15. Water Wash/Detergent System

Detergent wash and rinse will be accomplished with manifolds located on the air entering sides of the (prefilter wash collar if supplied) ionizing/collecting cell tier through spray nozzles delivering a cone shaped pattern. The detergent reservoir, pump, motor and bypass valve shall be provided as a prepackaged assembly with an adjustable detergent volume setting. The detergent pump motor shall be 0.75kW TEFV motor, 220v/50hz/1ph, with pump of positive displacement self priming and deliver not less that 6 GPM at 50 PSIG minimum outlet pressure. Pump motor shall contain built-in overload protection. Main water line strainer and solenoid valves are to be factory furnished with the system. Detergent system shall a 30-gallon tank for remote mounting with initial supply of biodegradable detergent as per unit manufacturer's recommendations.

16. Static Pressure Drops

The pressure drop shall not exceed the following (inches H₂O):

- ESP Section 0.14"
- Metal Mesh prefilter or after filter 0.10"

The ESP section must have both an internal prefilter and an after filter, select and add for each.

External losses for ductwork, exhaust hoods, manufacturing equipment with associated entry losses, kitchen hoods, etc..must be added with the above internal equipment losses to calculate total fan static pressure required.

17. Adsorber Module

The Adsorber Module shall be designed to utilize required number of 23.38" x 23.38" x 2" deep trays that are powder painted for corrosion resistance, may be reused and are secured in a V-bank arrangement on steel slide tracks. Trays shall be charged with 18.25 lbs. of activated carbon granules.

W. INLINE & PROPELLER FANS

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of centrifugal and inline fans conforming to these specifications and in accordance with the requirement of drawings and 'Schedule of Items'.

2. TYPE

Centrifugal and inline fans shall be of type as indicated in drawings and 'Schedule of Items'

3. INLINE FANS

Inline fan shall incorporate SISW direct driven centrifugal fan with TEFC (IP-44) motor. The fan assembly shall be enclosed in a sheet metal housing of 22 gauge GSS and with necessary inspection cover with proper gasket assembly. The fan material shall be galvanized sheet steel. Flanges shall be provided on both sides of inline fan to facilitate easy connection. Flexible anti-vibration joints shall be provided to arrest vibration being transferred to other equipments connected to inline fan. Motor shall be single phase/three phase as per duty conditions.

All single-phase fans shall be provided with speed regulators while all three phase fans shall be provided with opposed blade dampers in GSS construction at fan outlet for air balancing.

4. PROPELLER FANS

Propeller fans shall be direct driven, three or four blade type mounted on a steel mounting plate with orifice ring.

Mounting plate shall be of steel construction, square with streamlined venturi inlet coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge steel sheet depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

Fan blades shall be constructed of aluminum or glass reinforced polypropylene. Fan hub shall be of heavy welded steel construction with blades bolted to the hub fan blades and assembly shall be statically and dynamically balanced

Shaft shall be of steel accurately ground and shall not pass through first critical speed through entire range of specified fan speed.

Motor shall be standard permanent split capacitor of shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for a quiet operation with a maximum speed of 1000 RPM for fans 60 cm dia. or larger and 1440

RPM for fans 45 cm dia. and smaller. Motors for larger fans shall be suitable for $415 \pm 6\%$ volts. 50 cycle 3-phase power supply and for smaller fans shall be suitable for $220 \pm 6\%$ volts, 50 cycles single-phase power supply. Motors shall be suitable for horizontal or vertical service as indicated in drawings and Schedule of Quantities. Propeller fans shall be provided with following accessories:

- a. Wire guard and bird-screen
- b. Gravity louvers at outlet
- c. Regulator for controlling fan speed for single-phase fan motor.
- d. Single-phase preventors for 3 phase fans.
- e. Wiring between regulator and fan motor including termination at both ends.

5. PERFORMANCE DATA

All fans shall be selected for the lowest operating noise level. Capacity rating, power consumption with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of installation.

6. TESTING

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings, power consumption shall be computed from measurements of incoming voltage and incoming current.

X. VENTILATION FAN SECTIONS

1. GENERAL

- a. Fans shall be of the type, size, arrangement and capacity as indicated in the schedule and/or as shown on the drawings.
- b. Unless specified, fan performance rating data shall be tested accordance with AMCA Standard 210-85(Air Moving and Conditioning Association), ANSI/ASHRAE Standard 51-1985 "Laboratory Methods of Testing Fans for Rating". Sound ratings shall conform to AMCA Standard 300-85, "Reverberant Room Method for Sound Testing of Fans".
- c. A computer printout of fan performance rating corresponding to the AMCA licensed data, with corrected ratings for altitude and temperature, fan operating speed, bearing life, etc. shall be submitted for approval.
- d. All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly. A computer printout with the vibration spectrum analysis shall be attached to the fans.
- e. Fan motors shall comply in all respects with continuous rating in accordance with IEC34 or equivalent. Motor bearings shall be of ball or roller type, grease or lubricant sealed for life. Fan and drive shall be earthed to prevent accumulation of static charge.
- f. Kitchen exhaust fan shall be of Bifurcated Axial or SISW Centrifugal direct or belt driven type. DIDW Centrifugal and Direct Drive Axial Flow Fan where belts or motor are in the air stream are not acceptable.
- g. Fans shall be installed at staircase or lobby where fresh air intake is free from any obstruction and shall be energized only by fire alarm system. Fan shall be of Axial Flow Fan or DIDW Centrifugal Fan. Protective grille at the suction of the fan is required.
- h. Fans for elevated temperature (Smoke Extraction Fans) with components rated for high temperature (250C, 2Hrs) service, with belt drive assemblies exposed to the air stream are not acceptable.
- i. For Smoke Extraction Fans where motor is in the air stream with electrical/ electronic temperature limit switch for motor protecting shall not be used.
- j. Fan should be of G.S.S., the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skinpassed, chromated and dry.
- k. If fan is open to atmosphere, Fans shall be with Pure polyester powder coating for minimum thickness of 60 microns.

2. AXIAL FLOW FANS (DIRECT DRIVE)

- a) Fans shall be licensed to bear the AMCA Seal. The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51-1985 "Laboratory Method of Testing Fans for Rating" and AMCA 300 "Reverberant Room Method for Sound Testing of fans".
- b) To achieve the minimum and equal clearance between the blade tips and casing, tube casing shall maintain its roundness by means of using one piece of sheet metal with 90 edge flanging up.
- c) Fan motor base support shall be properly secured (locked and sealed) to the fan housing and be of adjustable type to have precise control of motor shaft central position as well as running clearance between blade tips and casing. Motor (KW/HP) shall be able to be changed or upgraded at site without changing fan housing or ducting construction.
- d) Fans supplied shall be complete with factory fabricated mounting bracket (ceiling or foot mounted) and suction/ discharge matching flanges as accessories.
- e) All hubs shall be cast Aluminum alloy (Grade LM2) unless for Smoke Extractor Fans where high temperature (250C/2Hrs) air is expected then Aluminum alloy or steel fan impeller blades are required. Otherwise impeller blade material with Polypropylene (PP), Glass-reinforced

Polypropylene (PPG) and Glass-reinforced Polyamid (PAG), to provide self-balancing, anti-static, anti-sparking characteristic is preferable.

- f) Running clearance between blade tips and casing shall not exceed 1% of the impeller diameter, and 2% for smoke spill high temperature fan where mechanical expansion coefficient is different from normal ambient temperature. Fan manufacturer shall provide the fan assembled with the same clearance between blade tips and casing of the tested prototype. Note that the air performance and pressure loss are greatly affected by this clearance.
- g) Impellers shall be secured to the drive shaft by a key and keyway. Axial location shall be provided by a collar or shoulder on the drive shaft together with a retaining washer and screw fitted into a tapped hole at the end of the shaft and locked in position. Blades shall be secured in place to the angle setting by setscrews, locking nuts or setting pins.
- h) Fan motor shall be totally enclosed and external terminal box of at least IP55 shall be provided.
- i) Fan RPM shall be 1450 for fan above 5000 cfm capacity however below 5000 cfm capacity RPM will be 2850.
- j) All fans after assembly shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade. A computer printout with vibration spectrum analysis shall be attached to the fans.
- k) Fan should be of G.S.S., the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skinpassed, chromated and dry.

3. VANE AXIAL FLOW FANS (DIRECT DRIVE)

- a. Fan shall be licensed to bear AMCA seal.

To achieve the minimum and equal clearance between the blade tips and casing, tube casing shall maintain its roundness by means of using one piece of sheet metal with 90 edges flanging up with Fixed Guide Vanes.

- b. Fan Casing should be provided with Special Designed Integral **Straightening Vanes** to reduced turbulence provide high performance & low noise level.
- c. Fan motor base support shall be properly secured (locked and sealed) to the fan housing and be of adjustable type to have precise control of motor shaft central position as well as running clearance between blade tips and casing. Motor (KW/HP) shall be able to be changed or upgraded at site without changing fan housing or ducting construction.
- d. Fans supplied shall be complete with factory fabricated mounting bracket (ceiling or foot mounted) and suction/discharge matching flanges as accessories.
- e. All hubs shall be cast Aluminum alloy (Grade LM2) unless for Smoke Extractor Fans where high temperature (250C/2Hrs) air is expected then Aluminum alloy or steel fan impeller blades are required. Otherwise impeller blade material with Polypropylene (PP), Glass-reinforced Polypropylene (PPG) and Glass-reinforced Polyamide (PAG), to provide self-balancing, anti-static, anti-sparking characteristic is preferable.
- f. Impellers shall be secured to the drive shaft by a key and keyway. Axial location shall be provided by a collar or shoulder on the drive shaft together with a retaining washer and screw fitted into a tapped hole at the end of the shaft and locked in position. Blades shall be secured in place to the angle setting by setscrews, locking nuts or setting pins.
- g. Fans shall not exceed 1500 RPM.
- h. All fans after assembly shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade. A computer printout with vibration spectrum analysis shall be attached to the fans.

The Fan should be AMCA Certified for Air Performance.

- i. Fan should be of G.S.S., the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skinpassed, chromated and dry.

4. SMOKE EXTRACTION FAN

- a. Smoke and heat exhaust fans are required to be in compliance with the 'BSEN12101-3:2002'. This requires the fan to be subjected to a rated temperature of 250C for a rated duration of 120 minutes.
- b. The Type test report is to be submitted by fan manufacturer & same clearly indicate the make of motor used during the testing and the same make/model of motor should be supplied by the fan manufacture at the site
- c. The fan is required to satisfy the performance criteria specified in 'BSEN12101-3:2002' relating to structural performance, electrical performance and aerodynamic performance throughout the rated duration.
- d. The testing certificate or test report shall be issued by Warrington Fire Research Centre Ltd in U.K., PSB Singapore or approval equivalent test laboratory.
- e. For two-stage counter-rotating Smoke Spill Fan for high-pressure application, each impeller shall be driven by a separate motor within a separate casing.
- f. Fan should be of G.S.S., the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skinpassed, chromated and dry.

5. CENTRIFUGAL FANS

- a) Fans, Aerofoil, forward or backward curved, SISW or DIDW, shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal. The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51-1985 "Laboratory Method of Testing Fans for Rating" and AMCA 300 "Reverberant Room Method for Sound Testing of fans".
- b) All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly. A computer printout with vibration spectrum analysis shall be attached to the fans.
- c) Fan should be of G.S.S., the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skinpassed, chromated and dry.
- d) Fans housing shall be of an appropriate thickness to prevent vibration and drumming. The fan scroll shall be attached to the side plate by means of continuous lock seam or intermittent spot welding. The wheel and inlet cone shall be aerodynamically designed and constructed to provide maximum performance and efficiency as published by the manufacturer.
- e) Fans must be physically capable of operating safely at every point of rating at or below the "minimum performance" limit for that class as defined in AMCA standard 99-2408-69 "Performance Class of Operating Limits for Centrifugal Fans".
- f) Shafts sizes shall be carefully calculated and designed such that the maximum operating speed (RPM) shall not exceed 75% of the first critical speed. For any application that is not a standard product from catalogue of the fan manufacturer detailed calculation of critical speed characteristic shall be submitted for approval.
- g) Shafts shall be made of carbon steel (C45) machined and polished to tolerance of standard ISO 286-2 - grade g6. Protective coat of anti-rusting shall be applied to all bare surfaces of the shafts at the factory.
- h) Bearings shall be of self-alignment (concentric) type with adaptor sleeve bearing. Bearings of eccentric locking collar with grub screw type are not acceptable. Bearing shall be maintenance free with permanently lubricated sealed ball bearing type. Bearing life shall be at least 75,000 hours based on basic rating life, L10 of ISO 281 standard. Calculation sheet of Bearing Life shall be submitted for approval.
- i) Motor installed shall be of a minimum 130% of the fan power absorbed (Brake horsepower) and shall have sufficient torque available for starting and continuous operation.
- j) Belts and pulleys shall be sized for a minimum 150% of the installed motor horsepower. The belt speed shall not exceed 30m/s. The pulley shall be of Taper Lock SPZ, SPA, SPB or SPC type. Conventional type of pulley is not acceptable. Both fan and motor pulley shall be balanced to the quality grade G2.5.

- k) Fan outlet velocity shall not exceed 10% of the main duct air velocity designed (0.1" per 100 ft or 1 Pascal per meter duct length). Pressure Loss is as referred to in relevant Standard, unless otherwise specified.
- l) Computer printout on fan performance rating corresponding to the AMCA licensed data, with corrected rating for altitude and temperature, fan operating speed, bearing life, etc. shall be submitted for approval.
- m) **For Air washer Application, fans should have to coat of pure polyester powder coating. Fans should have Inspection door & Drain plug.**

Y. VAV TERMINAL BOXES

1. VAV TERMINAL BOXES - GENERAL

All the VAV Terminals shall be Pressure Independent type with Direct Digital Controls to regulate the primary air flow rate between the scheduled minimum and maximum values to achieve the specified comfort level within acceptable noise criteria. A separation shall be made in Induction VAV Terminals and Standard VAV Terminals as detailed in the schedule.

The Induction VAV Terminals shall induce room air, without need of an assisting fan, and mix it with conditioned primary air, maintaining a near constant air volume to the room thus providing sufficient air movement necessary to maintain occupant comfort even in extreme load variations.

The VAV terminal shall have the controls, actuators and transformers, etc. pre-fitted, wired and calibrated at the factory and supplied with its appropriate digitally communicating thermostat. The supply of the VAV Terminals and the VAV controls, as well as the commissioning at the site, shall be done by the same specialist/local supplier.

2. CONSTRUCTION OF STANDARD PRESSURE INDEPENDENT VAV TERMINALS

The casing shall be a double wall construction made from galvanized sheet steel (non spiral). Casing Leakage Rate shall be according to class II, VDI 3803/DIN 24 194. The insulation thickness shall be 25 mm. and the insulation material shall be fully enclosed by the metal casing. VAV Terminals with insulation materials in direct contact with the air flow will not be accepted.

The VAV Terminals shall have a low leakage, sandwich construction damper blade with SBR gasket and a solid aluminum damper shaft (diameter 12 mm.) with self lubricating Nylon bearings. The leakage shall be less than 2% of the nominal flow at 750 Pa. inlet static pressure. The duct sleeve connections at the inlet and outlet of the VAV Terminal shall be conform DIN 24 145 or DIN 24 146 respectively.

For large air volumes, Rectangular VAV Terminals shall be provided. These Rectangular VAV Terminals shall have a multi-leaf opposed blade damper with aluminum, aerofoil blade construction, width 50 mm. and external linkage. The damper spindle shall be made of steel (10 mm. diameter), rotating in self lubricating Nylon bearings. The VAV Terminal shall have 30 mm. flange connections at the inlet and outlet of the terminal.

Each VAV Terminal, Circular or Rectangular shall be factory fitted with a multipoint, averaging air flow sensor in the inlet of the terminal. This air flow sensor shall amplify the air pressure signal linearly with an amplification factor of at least 2.0. The air flow sensor shall contain not less than 2x12 sensing points, which shall be arranged in two perpendicular axis of sensing. The holes shall be arranged in such a way that each four points in a ring sense the air pressure across concentric circles of equal area in a round duct. The signal shall be averaged and measured from the center of the sensor. And the accuracy shall be within 2.5% even with irregular duct approach.

3. CONSTRUCTION OF INDUCTION VAV TERMINALS (PRESSURE INDEPENDENT)

The casing shall be rectangular type made from galvanized sheet steel (thickness 1.25 mm.) with a circular inlet, two Induction openings at the sides of the terminal and a rectangular outlet. The duct sleeve connections at the inlet and outlet of the VAV Terminal shall be conform DIN 24 145 or DIN 24 146 respectively. The VAV Terminal shall have internal insulation (thickness 25 mm.), tested HF-1 (UL 94) flame test and erosion proof up to 50 m/s air velocity.

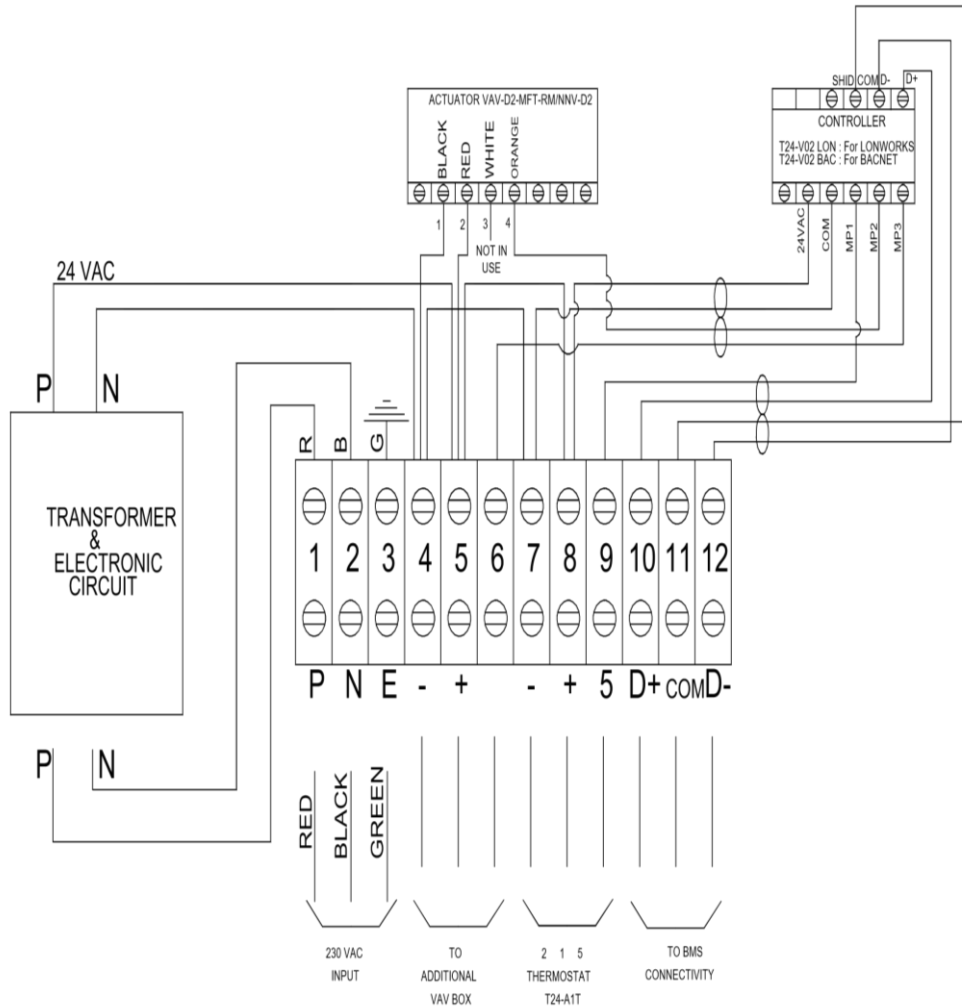
The terminals shall be fitted with a specially constructed jet-tronic damper to regulate the primary air flow between the scheduled minimum and maximum values. The same damper shall also generate and control the Induction effect through the acoustically lined induction chamber of the VAV Terminal. The damper shaft shall be solid aluminum (diameter 12 mm.), rotating in self lubricating Nylon bearings. The damper shall permit proper operation of the terminal over a range of 20 to 100% of maximum flow without the requirement of special VAV diffusers or assisting fans.

The Induction VAV Terminal shall be factory fitted with a multipoint, averaging air flow sensor in the inlet of the terminal. This air flow sensor shall amplify the air pressure signal linearly with an amplification factor of at least 2.0. The air flow sensor shall contain not less than 2x12 sensing points, which shall be arranged in two perpendicular axis of sensing. The holes shall be arranged in such a way that each four points in a ring sense the air pressure across concentric

circles of equal area in a round duct. The signal shall be averaged and measured from the center of the sensor.

And the accuracy shall be within 2.5% even with irregular duct approach.

Wiring Diagram



IMPORTANT: SEE THE WIRING - ACTUATOR1 NO WIRE IS CONNECTED TO THERMOSTAT 2 NO WIRE

Z. AUTOMATIC CONTROLS AND INSTRUMENTS

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of automatic controls and instruments conforming to these specifications and in accordance with requirement of drawings and 'Schedule of Items'

2. PRODUCTS

The Valve should have self-Dynamic Flow Control Valves that are pressure independent, two way, Modulating to accept digital/analog input BMS/Controller signals and should provide flow feedback signal to the control system. The Feedback signal should have the feedback feature of the Valve/Actuator itself without any need of any additional accessory/instrument/device.

- PICV should be capable of maintaining the max flow rate atleast +/-4% Accuracy
 - The PICV Should be capable of maintaining Linear Temperature Control, Pressure Independence and Electric Modulation in one Valve body.
 - The Flow rates should be field settable electronically upto 60% of the valve Max set Flow rate
 - Valve Actuator housing shall be rated to IP54
 - Actuator shall be driven by a 24Vac power supply and shall accept universal Input signals like 0/2-10Vdc or 4-20mA signal
 - Actuator shall be capable of providing feedback Signal of 0/2-10Vdc to the Control System/BMS
 - PICV should have an option for adjusting the Flow Characteristics as per AHU in every PICV to ensure Linear Temp Control.
 - PICV should have an option for changing the Max Flow Rates in future and no additional Instrument should be required. Flow Values can be changed by entering in LCD Display only and not by any DIP Switches or Setting Dial to improve accuracy.
 - PICV shall provide full valve Authority
 - PICV Valve body shall be rated at least PN16
 - Max Close off Pressure shall be mentioned in the Product Datasheet.
 - Min Working Differential Pressure shall be 30Kpa
 - Valve shall be Internal BSP Threaded from DN25 to DN50 and Flanged end Connection for DN65 to DN150
 - Media Temperature : 0-110 deg C
 - Valve shall be of Brass/Bronze Construction upto DN50 and Cast Iron upto DN150
 - Shut off Leakage shall be 0.1 Kvs
- All control valves to give flow feedback to BMS via Bacnet
 - All valve to be selected as per design flow rate requirement
- ii. Flow switches shall be provided in the condensing water line (outlet) and chiller water line (outlet) only near the chilling machine. The control supply of chilling units shall be interlocked with these flow switches.
 - iii. Thermostats shall be electrical mode, fixed differential type with sensing element located in the return air stream.
 - iv. Proportional control thermostats for air conditioning application for actuating the two ways or three way modulating valve at each air-handling units, as shown on drawings and included in Schedule of Quantities. Range shall be 56-84 degree F, differential shall be 3 degree F.
 - v. SNAP acting fixed differential thermostat for FCU shall be with temperature range of 13-29 degree C differential 37 deg C with ON/OFF, HI/LOW fan switch, normal-cool setting switching off must break fan circuit.

3. **Motorized Butterfly Valve**

The butterfly valves should be as per same specifications as of Butterfly valves with pressure rating of PN 16.

Electric Actuator should be On/Off Type with Protection class - IP67 & Power Supply of 230V AC as standard; Inbuilt Double Limit Switches, Over-hot & Overload Protection Features. Actuator Body shall be made of ABS/Die Casting Aluminum Alloy & internals made of Antirust & Anti - Corrosion Stainless Steel.

Valve Body	
Type of Valve	Butterfly Valve
Body Material	Cast Iron or Ductile Iron Body
Disc Material	SS-304
Stem	SS-420
Liner Material	EPDM
Nominal Static Body	PN16
Rating Tightness	Bubble Tight
Medium Temperature	-10 deg C to 120 deg C
Pipe Connection	ISO7005-2
Actuator Type	Electric
Motor Supply	230 VAC, 50Hz/60Hz
Travel Angle	90 deg +/- 5 deg
Enclosure	IP67 Waterproof
Indicator	Continuous Position Indicator
Space Heater	15W 220V AntiCondensation
Stall Protection	Built-in thermal protection Cut off at 125 ± 5 Reset at 95 ± 5
Manual Override	By Handwheel, nonclutch design
Torque Limit Switches	2 Nos.
External Coating	Dry Aluminium Alloy in Painted Black

4. INSTRUMENTS

i. Thermometer: Thermometers shall be dial type 100 mm dia or V form industrial type. Body shall be aluminum alloy, anodized gold colored surface. The casing shall be adjustable sideways for reading from the front. The glass capillary shall be triangular in shape with blue mercury filled in glass for better visibility. Scale of reading shall be of the range 0 deg C to 60 deg C & +32 deg F to 150 deg F. Graduation of scale shall be 1 deg in both readings. Ranges of scales shall be 30-90 degrees F (0-50 deg C) for all conditioning applications of cooling only. Thermometer shall be suitable for 15mm connection. Thermometer for chilled water shall be with long stem so that thermometer is removable without damaging the insulation ms socket to be welded / inserted using hote cut grooved method on pipes shall be provided with thermometer. Thermometer shall be installed of chilled water supply and return at each air handling unit, supply and return of each chiller, condenser.

ii. Pressure gauge: shall be installed on suction header and at discharge side of each pump in the chilled water supply and return at each air handling unit, at inlet and outlet of each chiller. Suction side gauge at pump suction header shall be compound gauge with 150 MM dia, range 75 cm vacuum to 10 kg pressure. Discharge side gauge at pumps and at all other locations shall be 150mm range 0-10 kg per sq cm (0-150 PSI) Pressure.

iii. **Thermostats**

Thermostats shall be electric fixed differential type as indicated below, with sensing element located in the return air stream. All thermostats shall be supplied with the standard mounting boxes as recommended by the manufacturer. The profile, mounting arrangement and exact location of the thermostat shall be such as to suit the site.

- I) Proportional control thermostats shall be provided for actuating the three way modulating valve at each air handling unit. Thermostat shall provide manual switching (heat-off-cool-in heating-cooling system).
- II) Snap-acting fixed differential type thermostat for actuating the three-way diverting valve at each fan coil unit.

Thermostat shall have temperature adjustments WARM-NORMAL-COOL settings and fan switch. Switching off must break fan circuit.

- III) Snap-acting fixed differential heating thermostat for electric winter heating and reheat applications for putting on/off power supply to electric heating or reheat coils in air handling units.
- IV) Safety thermostat shall be provided for electric winter heating and reheat application for cutting off power supply to strip heaters in case air flow across strip heater is not established.
- V) Air-stat shall be provided within air handling unit containing electric heating or reheat coils to prevent heaters from energizing unless the air flow is established.

iv. **Humidistats**

Humidistat shall be provided with air handling unit for areas, which require humidity control. One humidistat shall activate the reheat coils in case the space humidity rises beyond the preset limit. Another humidistat shall energize the humidifier when the humidity falls below the preset limit. These humidistats shall also de-energize these devices when the desired humidity is reached.

Humidistats shall be snap-acting type having humidifier/dehumidifier control from 20-80 percent relative humidity, with differential of 5 percent. Humidistat shall have nylon element with three bobbins, and removable knob to prevent tempering of set point.

v. **AUTOMATIC BALANCING VALVES** for Chiller/condenser line: Size : 100-1000 mm size
AUTOMATIC BALANCING VALVES WAFER type Valve shall consist of a dynamic, flow limiting device.

VALVE housing shall be constructed of ductile iron ASTM A536, Class 60-40-18; rated at no less than 3400 kPa static pressure at +175°C; shall have single or multiple, parallel installed stainless steel cartridge assemblies (Flow regulation unit assembly shall be manufactured of stainless steel and stainless steel spring.), to provide rated flow rate.

- Valve shall be permanently marked to show direction of flow.
- Dual pressure/ temperature test plugs for verifying accuracy of flow performance shall be provided for all valve sizes.
- Flow regulation unit shall be available in four different kPa operational ranges; minimum range shall be capable of being activated by minimum 10kPaD; and shall be capable of controlling flow within +/-5% of rated flow.
- Identification tag shall be available for all valves; tag can be indelibly marked with model number, flow rate.

AA. SHEET METAL WORKS AND ACCESSORIES - (MANUAL FABRICATION)

1. SCOPE

The scope of this section includes supply, fabrication, installation & testing of all sheet metal ducts, supply, installation, testing & balancing of all grills & diffusers as per specifications & drawings.

Except as otherwise specified all ductwork and related items shall be in accordance with these specifications.

Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners, hangers & all accessories.

2. DUCT MATERIALS

The ducts shall be fabricated from galvanized steel sheets class VIII - Light coating of Zinc conforming to ISS: 277-1962 (REVISED) and with a galvanizing thickness of nominal 120 gm. per SQM surface area.

i. Only new, fresh, clean (unsoiled) and bright GI/Aluminum sheets shall be used. The AAHII reserve the right to summarily reject the sheets not meeting these requirements. Fabrication of ducts shall be through Lock forming machines.

ii. All duct work, sheet metal fabrication unless otherwise directed, shall strictly meet requirements, as described in IS:655-1963 with Amendment-I (1971 Edition)

Longer size of Duct	Sheet Thickness GI (MM)	Type of Joints	Bracing
Up to 750	0.63	GI Flange	-
751-1000	0.80	25x25x3 mm angle iron frame with 8 mm Dia nuts & bolts	25X25X3 MM @ 1M
1001-1500	0.80	40x40x5 mm angle iron frame with 8 mm Dia nuts & bolts	40x40x5 MM @1M
1501-2250	1.00	50x50x5 mm angle iron frame with 10 mm Dia nuts & bolts at 125 mm center	40x40x3 mm @ 1.2m to bebraced diagonally.
2251 & above	1.25	50x50x6 mm angle iron frame with 10 mm Dia nuts & bolts at 125 mm center	40x40x3 mm @ 1.6m diagonally braced

iii. Ducts larger than 450 mm shall be cross broken, duct sections up to 1200 mm length may be used with bracing angles omitted.

iv. Changes in section of ductwork shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 Deg. Angle from the axis of the main duct unless otherwise approved by the Engineer-in-Charge.

v. All ducts shall be supported from the ceiling/slab by means of M.S. rods of 10 MM Dia with M.S. angle at the bottom of size 40 mm x 40 mm x 6 mm for sizes up to 1500 mm at 3 m intervals. Above size 1500 mm upto 2250, support shall be provided with 10 mm dia. MS rod and MS angle size 50 mm x 50 mm at bottom at 2.5 m intervals. Above size 2250 mm support shall be provided with 12 mm dia MS rod and MS angle size 50 mm x 50 mm at bottom

3. INSTALLATION

i. All ducts shall be fabricated and installed in workman like manner, generally conforming to relevant BIS codes. Round exposed ducts shall be die formed for achieving perfect circle configuration

a. Ducts so identified on the drawing shall be acoustically lined and thermally insulated as described in the section 'Insulation' and as indicated in 'Schedule of Quantities. Duct

dimensions shown in drawings are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in 'Schedule of Quantities'.

- b. Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made airtight.
 - c. All exposed ducts upto 60 cm width within conditioned spaces shall have slip joints. The internal ends of the slip joints shall be in the direction of airflow. Ducts and accessories within ceiling spaces visible from air-conditioned areas shall be provided with two coats of matt black finish paint.
 - d. Change in dimensions and shape of ducts shall be gradual. Air turns shall be installed in all vanes arranged to permit the air to make the turn without appreciable turbulence.
 - e. Ducts shall be fabricated as per details shown on drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees of ample size to keep the ducts true to shape and to prevent buckling, vibration or breaking.
 - f. All sheet metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans shall be constructed of 18 Gauge GSS thoroughly stiffened with 25mm x 25mm x 3mm angle iron braces and fitted with all necessary inspection doors as required to give access to all parts of the apparatus. Doors shall be not less than 45cm X 45cm in size.
 - g. Plenums shall be panel type and assembled at site. Fixing of MS angle iron flanges of duct pieces shall be with rivet heads inside i.e. Towards G.S. sheet and riveting shall be done from outside.
 - h. Rubber gasket 3 mm thick shall be used between duct flanges and between duct and duct supports instead of felt in all ducting installation for complete sealing.
- ii. During the construction, the Contractor shall temporarily close duct openings with sheet metal covers to prevent debris-entering ducts and to maintain opening straight and square, as per direction of Engineer-in-Charge.
- a. Great care should be taken to ensure that the ductwork does not extend outside and beyond height limits as noted on the drawings.
 - b. All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be tight and shall be made in the direction of airflow.
 - c. The ducts shall be reinforced where necessary, and must be secured in place so as to avoid vibration of the duct on its support.
 - d. All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration. All ducts shall be fabricated and installed in accordance with modern design practice. The sheet metal gauges and fabrication procedures as given in I.S. specifications shall be adhered to and shall be considered as an integral part of these specifications.
 - e. The ductwork shall be varied in shape and position to fit actual conditions at building. All changes shall be in accordance with accepted duct design and subject to the approval of the Engineer-In-Charge. The Contractor shall verify all measurements at building and shall notify the Engineer-In-Charge of any difficulty in carrying out his work before fabrication.
 - f. Sponge rubber or approved equal gaskets shall be installed between all connections of sheet metal ducts to walls. Sheet metal connections shall be made to walls and floors by means of galvanized steel angles anchored to the building structure with anchor bolts and with the sheet bolted to the angles. Sheet metal connections shall be as shown in the drawings or as directed by Engineer-In-Charge.
 - g. All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angel/channel under ducts. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of

galvanized steel rods and angles/ channels shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/ anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats.

- h. Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick TF quality thermo Cole around the duct prior to sealing of the opening.
- i. All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 100 mm long but not more than 200 mm, securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.
- j. Flanges and supports are to be black, mild steel and are to be primer coated on all surfaces before erection and painted with aluminum thereafter. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.
- k. The ductwork should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling Contractors.

4. DAMPERS

At the junction of each branch duct with main duct and split of main duct, volume control dampers must be provided. Dampers shall be rigid in construction to the passage of air.

The volume dampers shall be of an approved type, lever operated and complete with suitable level links & quadrants, locking devices, which will permit the dampers to be adjusted and locked in any position.

The dampers shall be of opposed blade or louver type. The damper blade shall not be less than 1.25 mm (18) gauge and shall not be over 225 mm wide. Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Damper frames shall be constructed of 16 gauge steel

After completion of the ductwork, dampers are to be adjusted and set to deliver the required amount of air as specified in the drawings.

5. ACCESS PANEL

A hinged and gasket access panel shall be provided on ductwork before each control device that may be located inside the ductwork. Doors shall be provided with neoprene rubber gaskets. Angle joints shall be provided with neoprene rubber gaskets for leak tightness of the joints. Access door/panels shall be provided: - Near each smoke sensor Any other place specifically mentioned in the drawing or if asked by AAHII during execution stage.

6. MISCELLANEOUS

- a. Sponge rubber gaskets also to be provided behind the flange of all grills.
- b. Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.
- c. Inspection doors measuring at least 450 mm x 450 mm are to be provided in each system at an appropriate location, as directed by Engineer-In-Charge.
- d. Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.
- e. Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Engineer-In-Charge.
- f. All duct supports, flanges, hangers and damper boxes etc. Shall be given 2 coats of red oxide paint before installation and one coat of aluminum paint after the erection, at no extra cost.
- g. All angle iron flanges are to be welded electrically and holes to be drilled.
- h. All the angle iron flanges are to be connected to the GSS ducts by rivets at 100 mm centers.

BB. GRILLS / DIFFUSERS

1. SUPPLY AND RETURN AIR DIFFUSERS

Supply and return air diffusers shall be made of extruded aluminum section. The diffusers shall be powder coated in finish. Supply air diffusers shall be provided with screw operated opposed blade volume control devices of extruded aluminum in black anodized finish. The diffusers shall be suitable for concealed fixing arrangement and as approved by Engineer-In-Charge/AAHII.

The diffusers shall be provided with removable central core.

All diffusers shall be selected as per selection curves and in consultation with Engineer-In-Charge/ AAHII. All diffusers shall have soft continuous rubber/foam gasket between the periphery of the diffusers and the surface on which it has to be mounted.

a. LINEAR GRILLS:

Linear continuous supply or return air grills shall be extruded aluminum construction with fixed horizontal bars at 15 degree inclination with flanges on both sides. The thickness of fixed bar louvers shall be 5mm in front and the flange shall be 20mm wide with round edges. The grille shall be suitable for concealed fixing and horizontal bars of the grille shall be mechanically crimped from the back to hold them.

Volume control device of extruded aluminum construction in black anodized finish shall be provided in S.A. duct collars.

b. DOUBLE ADJUSTABLE LOUVERED SUPPLY/ RETURN AIR GRILLS WITH HORIZONTAL /VERTICAL OR VERTICAL/ HORIZONTAL LOUVER ARRANGEMENT:

The grille shall be adjustable as each louver shall be pivoted to provide pattern with 00 to plus or minus 150 ARC upto 300 deflection down towards. The louvers shall hold deflection settings under all conditions of velocity and pressure. The rear louver of the register shall be in black shade.

Volume control device of extruded aluminum construction with black anodized finish shall be provided in S.A. grills.

c. EXHAUST AIR REGISTER:

Exhaust air register shall be made of extruded aluminum with fixed horizontal louvers at 40 degree angle setting on a 20 mm louvers pitch. The register shall have 20 mm wide flange with round edges all around. The register shall be suitable for front screw fixing.

Volume control device of extruded aluminum construction with black anodized finish shall be provided.

d. MULTI SLOT CEILING DIFFUSERS:

Multi slot ceiling diffuser shall be made of extruded aluminum with various slot width and air pattern deflectors. Deflectors in each slot provide an adjustable air pattern of 180 degree full. A special plenum shall be provided for each supply air diffuser. The linear diffuser shall have alignment strips to give straight look while installation.

Hit & miss type volume control damper of extruded aluminum construction with mill finish shall be with multi-slot supply air diffuser.

e. LINEAR CEILING MOUNTED DIFFUSERS:

Linear ceiling mounted air terminals shall be made of extruded aluminum surface mounted one way or two way pattern. The linear terminal shall have alignment strips to give straight look while installation. Volume control device of extruded aluminum construction in mill finish shall be provided in S.A. diffuser.

f. FRESH AIR INTAKE LOUVERS:

Fresh air intake louvers 50 mm deep (minimum) wherever required as per shop drawing will be made of extruded aluminum construction duly anodized or powder coated. Bird/insect screen will be provided with the intake louvers. The blades are inclined at 45° on a 40 mm blade pitch to minimize water ingress. The lowest blade of the assembly shall extend out slightly to facilitate disposal of rainwater without falling in door/wall on which it is mounted.

Wherever specified, the intake louvers shall be provided with factory fitted all aluminum construction volume control dampers in black anodized finish.

g. LAMINAR FLOW DIFFUSERS

i. Introduction

Diffusers are available for flush mounting in the ceiling. Suitable angle frames are also provided for the modular panel construction. The units are available in three standard sizes for top entry complete with opposed blade dampers

- ii. Description
LFD laminar flow diffusers are constructed from 18 swg Aluminium sheet, perforated face with approx 50% perforation. The perforated front face is openable hinge type complete with key operated dampers from front.
 - iii. Sizes
Available in standard sizes of 600 x 600 mm, 900 x 600 mm & 1200 x 600 mm or as per requirements.
 - iv. Features
 - a. Suitable for modular panel assemblies.
 - b. Top entry with opposed blade dampers.
 - c. Pivoting type face plate for damper operation from front.
 - d. Easy maintenance and cleaning
 - v. Finishes Standard
 - a) Epoxy Polyester Powder Coated off white/pure white
 - b) Natural anodised.
2. **MOTORIZED COMBINED SMOKE & FIRE DAMPERS – SPRING RETURN**
All supply and return air ducts at AHU room crossings and at all floor crossings or as indicated in the drawings shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating.
These shall be of multi-leaf type and provided with Spring Return electrical actuator having its own thermal trip for ambient air temperature outside the duct and air temperature inside the duct.
Actuator shall have Form fit type of mounting, metal enclosure and guaranteed long life span. The dampers shall meet the requirements of NFPA90A, 92A and 92B. Dampers shall have a fire rating of 1.5 Hrs. in accordance with latest edition of UL555 and shall be classified as Leakage Class 1 smoke damper in accordance with latest edition of UL555S. Each fire/smoke damper shall be AMCA licensed and bear the AMCA seal for air Performance. Actuators used shall be UL listed.
Each damper shall be supplied with factory mounted sleeve of galvanized steel of thickness and of minimum 400mm long or as specified in schedule of quantities depending up on the wall thickness. The damper shall be fitted in to sleeve either using welding or self-tapping screws. All welded joints shall be finished using heat resistance steel paint, UL listed and approved Silicon sealant shall be applied at all corners as well as at joints between damper frame and sleeve.
Damper Frame shall be a roll formed structural hat channel, reinforced at corners, formed from a single piece of 1.5mm galvanized steel. Damper blades shall be aerofoil shaped (equivalent to 2.0mm thickness strength) roll formed using 1.0mm thick single piece of galvanized sheet. Bearings shall be of stainless steel fitted in an extruded hole in the damper frame. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Side Jam seals of stainless steel and Top and bottom seals of galvanized steel shall be provided. All galvanized steel used shall be with minimum 275 gm/ Sq.m Zinc coating. Bigger size Dampers shall be supplied in multiple modules of sizes not exceeding in dimensions of certified module, jack shafted together. Multiple actuators shall be provided for large dampers with higher torque requirements as prescribed in UL.
The electric actuator shall be energized either upon receiving a signal from smoke detector installed in AHU room supply air duct/ return air duct. Electric Actuator of suitable Torque and as approved by UL shall be factory mounted and tested. The actuator shall be suitable for 230V AC supply. In addition actuator shall have elevated temperature rating of 350 deg. F. Electric Actuator shall have been energized hold open tested for a period of at least one year with no spring return failure. Each fire/smoke damper shall be equipped with a heat actuated release device which shall allow controlled closure of damper rather than instantaneous to prevent accident (Electrical fusible link). The damper shall be equipped with a device to indicate OPEN and CLOSE position of Damper blades through a link mounted on the damper blade.
Each damper shall be provided with its own control panel, mounted on the wall and suitable for 230 VAC supply. This control panel shall be suitable for spring return actuator and shall have at least the following features:
- Potential free contacts for AHU fan ON/ OFF and remote alarm indication.
 - Accept signal from external smoke / fire detection system for tripping the electrical actuator.
 - Test and reset facility.

Indicating lights/ contacts to indicate the following status:

- Power Supply On
- Alarm
- Damper open and close position.

Actuators shall be mounted on the sleeve by the damper supplier in his shop and shall furnish test certificate for satisfactory operation of each Motor Operated Damper in conjunction with its control panel. Control panel shall be wall mounted type.

It shall be HVAC Contractor's responsibility to co-ordinate with the Fire Alarm System Contractor for correctly hooking up the Motor Operated Damper to Fire Detection/ Fire Management System. All necessary materials for hooking up shall be supplied and installed by HVAC Contractor under close co-ordination with the fire protection system contractor.

HVAC Contractor shall demonstrate the testing of all Dampers and its control panel after necessary hook up with the fire protection/ fire management system is carried out by energizing all the smoke detectors with the help of smoke.

HVAC Contractor shall provide Fire retardant cables wherever required for satisfactory operation and control of the Damper.

HVAC Contractor shall strictly follow the instructions of the Damper Supplier or avail his services at site before carrying out testing and installation at site.

Fire/smoke damper shall be provided with factory fitted sleeves; however, access doors shall be provided in the ducts within AHU room in accordance with the manufacturer's recommendations.

The Contractor shall also furnish to the Owner, the necessary additional spare actuators and temperature sensor (a minimum of 5% of the total number installed) at the time of commissioning of the installation.

3. PAINTING

All grilles, and diffusers shall be powder coated in color as approved by Engineer-In-Charge/AAHII before installation.

All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in Matt finish.

4. TESTING

After completion, all duct system shall be tested for air leakage.

The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final balance of air quantity through each outlet shall be submitted to the Engineer-In-Charge for approval. Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5% in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time.

CC. SHEET METAL WORKS – (FACTORY FABRICATED)

1. GENERAL

- i. The work under this part shall consist of furnishing labour materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, and exhaust system ready for operation as per drawings.
- ii. Except as otherwise specified all duct work and related items shall be in accordance with these specifications.
- iii. Ductwork shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.

2. DUCT MATERIALS

- i. The ducts shall be fabricated from galvanized steel sheets class VIII conforming to ISS:277-1962 (revised) or aluminium sheets conforming to ISS:737-1955 (wherever aluminium ducts are specified).
- ii. All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in IS:655-1963 with amendment-I (1971 edition)
- iii. GOVERNING STANDARDS:- Unless otherwise specified here, the construction, erection, testing and performance of the ducting system

3. RAW MATERIAL

- i. Ducting
 - a. All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill test Certificates.
 - b. Galvanizing shall be of 120gms/sq.m. (total coating on both sides).
 - c. In addition, if deemed necessary, samples of raw material, selected at random by AAHII's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.
 - d. The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross section dimensions.
- ii. Duct Connectors and Accessories
All transverse duct connectors (flanges/cleats) and accessories/related hardware are such as support system shall be zinc-coated (galvanized)/ FABRICATION STANDARDS
- i. All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces to provide the requisite quality of ducts and speed of supply.
- ii. Coil lines to ensure location of longitudinal seams at comes/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.
- iii. All ducts, transformation pieces and fittings to be made on CNC profile cutlers for required accuracy of dimensions, location and dimensions of notches at the folding lines.
- iv. All edges to be machine treated using lock formers, flanges and roller for fuming up edges.
- v. Sealant dispensing equipment for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified.

4. SELECTION OF G.I. GAUGE AND TRANSVERSE CONNECTORS

Duct Construction shall be in compliance with 1" (250 Pa) w.g. static.

All transverse connectors shall be the Rolamate 4-bolt slip-on flange system or Techno Fabriduct imported makes of similar 4-bolt systems with built-in sealant if any to avoid any leakage additional sealant to be used.

The specific class of transverse connector and duct gauge for a given duct dimensions will be 1"(250 Pa) pressure class.

Non-toxic, AC-applications grade P.E. or PVC Casketing is required between all mating flanged joints. Gasket sizes should conform to flange manufacturer's specification.

5. DUCT CONSTRUCTION

The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.

6. DIMENSIONAL TOLERANCES:

- a. All fabricated dimensions will be within +/- 1.0 mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be +/- 1.0 mm per meter.
- b. Each and every duct pieces should be identified by color coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge.
- c. Ducts shall be straight and smooth on the inside Longitudinal seams shall be airtight and at comers only, which shall be either Pittsburgh or Snap Button Punch, to ensure air tightness.
- d. Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the tum without appreciable turbulence.
- e. Plenums shall be shop/factory fabricated panel type and assembled at site.
- f. Factory Fabricated ducts shall have the thickness of the sheet shall be as follows.

S. No.	Size of Duct	Sheet Thickness	Fastner Size	Type of Joints		Bracing with GI tie rods of following sizes	Support Angle
1	Upto 750 mm	0.63 mm	3/8"	Fabricated out of G.I. sheet of 24 gauge at every 1.2 m internal.	The flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt	Cross tie rods to be fitted of suitable dia GI rod for each piece of duct	25x25x3 mm
2	751 mm to 1000 mm	0.80 mm	3/8"	E-24 type flange, shall be fabricated out of 24 G sheet at every 1.2 m internal.			25x25x3 mm
3	1001 mm to 1500 mm	0.80 mm	5/8"	E-22 type flange shall be fabricated out of 22 G sheet at every 1.2 m internal.	The flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt	Cross tie rods to be fitted of suitable dia GI rod for each piece of duct	40x40x5 mm
4	1501 mm to 2250 mm	1.00 mm	5/8"	J-16 type flange, shall be fabricated out of 16G sheet at every 1.2m internal.			40x40x6 mm angle
5	2251 mm and above	1.25 mm	5/8"	J-16 type flange, shall be fabricated out of 16G sheet at every 1.2 m internal.			50x50x6 mm with MS rods of 12 mm dia.

- g. The gauges, joints and bracings for sheet metal duct work shall further conform to the provisions as shown on the drawings.
- h. Ducts larger than 600 MM shall be cross broken, duct sections upto 1200 MM length may be used with bracing angles omitted.

- i. Changes in section of ductwork shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer-In-Charge.
- j. All ducts shall be supported from the ceiling/slab by means of M.S. Rods of 10 MM (3/8") DIA with M.S. Angle at the bottom. The rods shall be anchored to R.C. Slab using metallic expansion fasteners.

7. INSTALLATIONS

- i. During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of Engineer-In-Charge.
- ii. Great care shall be taken to ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.
- iii. All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow.
- iv. The ducts shall be re-inforced with structured members where necessary, and must be secured in place so as to avoid vibration of the duct on its support.
- v. All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration.
The duct work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the Engineer-In-Charge. The contractor shall verify all measurements at site and shall notify the Engineer-In-Charge of any difficulty in carrying out his work before fabrication.
- vi. Sponge rubber or approved equal gaskets of 6 MM maximum thickness shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. Sheet metal connections shall be made to walls and floors by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.
- vii. Flanges bracings and supports are to be Rolamate or Techno Fabriduct. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.
- viii. Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineer-In-Charge.
- ix. Joints requiring bolting or riveting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. All jointing material must have a finish such as cadmium plating or Galvanized as appropriate.
- x. Fire retarding flexible joints are to be fitted to the suction and delivery of all fans. The material is to be normally double heavy canvass or as directed by Engineer-In-Charge. On all circular spigots the flexible materials are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.
- xi. The flexible joints are to be not less than 75 MM and not more than 250 MM between faces.
- xii. The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.
- xiii. Duct passing through brick or masonry, wooden frame work shall be provided within the opening. Crossing duct shall have heavy flanges, collars on each side of wooden frame to make the duct leak proof.

8. DOCUMENTATION TO MEASUREMENTS

For each drawing, all supply of ductwork must be accompanied by computer-generated detailed bill of material indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct areas by gauge and duct size range as applicable.

Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge wise.

All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

9. TESTING

After duct installation, a part of duct section (approximately 5% of total ductwork) may be selected at random and tested for leakage.

DD. INSULATION:

PART 1 – GENERAL

WORK INCLUDED

- A. Comply with the schedule of Quantity, General Requirements and all documents referred to therein.
- B. Provide all labour, materials, products, equipment and services to supply and install thermal insulation, vapour barriers and finishes for mechanical work as indicated on the Tender drawings and specified in this Section of these Specifications.

SUBMITTALS

- A. Submit samples and specification sheets of all types of insulation materials specified in this Section of the Specifications.

PART 2 – PRODUCTS

Nitrile Rubber (For Refrigerant Pipe):

The minimum thickness of material used for duct thermal insulation shall be 25mm

1. Closed cell Elastomeric Nitrile Rubber: Thermal insulation material for Duct & pipe shall be closed cell Elastomeric Nitrile Rubber of Thermal conductivity of the insulation material shall not exceed 0.032 W/m degree K or 0.212 BTU / (Hr-ft²-oF/inch) at an average temperature of 30oC(The thermal conductivity shall be as per ECBC Code). Density of the nitrile rubber shall be 40-60 Kg/m³. The product shall have temperature range of -40 degree C to 105 degree C. The insulation material shall be fire rated for Class 0 as per BS 476 Part 6 : 1989 for fire propagation test and for Class 1 as per BS 476 Part 7, 1987 for surface spread of flame test. Water vapour permeability shall be not less than 0.024 perm inch (2.48 x 10⁻¹⁴ Kg/ms Pa i.e. $\mu > 7000$: Water vapour diffusion resistance
- A. The manufacturer shall have to provide the test report for insulation which will include minimum of the following parameters like density, Temperature range, Water absorption, Puncture resistance, Fire rating, etc.
 - B. Attain a complete and continuous vapour barrier over insulation applied to cold and dual temperature piping, sheet metal and equipment. Use either factory applied vapour barrier jacket or field applied Reinforced Foil Flame Resistant Kraft vapour barrier jacket. Apply to piping, fittings, valves and inline components, sheet metal and fittings and equipment. Seal longitudinal and circumferential laps. If vapour barrier jacket is not lapped, seal joints with self-adhering 100mm wide plain aluminium foil tape, or adhere 100mm wide aluminium foil tape with adhesive. Jacketing with self-adhesive laps and self-adhesive vapour barrier tape will be an acceptable alternative closure system.

Pipe Insulation

Pipe insulation for Plant Room/Terrace pipe shall be with duly insulated with fire retardant quality expanded polystyrene moulded pipe section of density 20 kg/cu.m after strong bond adhesive (1k pur/ equivalent) and the pipe section insulation shall be finished with two coats of 500 micron (0.5 mm) WFT Fire Retardant weathering resistant coating conforming to ASTM 6695 and having excellent rainwater resistant, high level water primality resistant and must be Anti-Fungal and Anti-Mold(both properties) conforming to relevant internationally acclaimed std. such as ASTM D 6904, ASTM D 2842, ASTM D 5590 and ASTM D 5589 the coating has to confirmed to ASTM E 96 for water vapor permeability and coating fire resistance properties such ASTM 4804 and ASTM E 84 sandwiched with 11 Mil Class E Glass Cloth.

The pipe within the building (in shafts, inside building etc.) shall be insulated with with fire retardant quality expanded polystyrene moulded pipe section of density 20 kg/cu.m after

strong bond adhesive (1k pur/ equivalent) and two coats of 500 micron (0.5 mm) WFT Fire Retardant coating conforming to UL 723 Class A and ASTM 4804, sandwiched with 7 Mil Class E Glass Cloth.

- I. Expanded polystyrene Thickness of insulation shall be as per table given below :

Pipe nominal bore	Thickness of insulation
20mm – 125mm	50mm
150mm – 400mm	75mm
Above 400mm	100mm

INSULATION (CHILLER)

Following procedure shall be followed for chiller insulation if required to be executed at site.

Chiller surface shall first be cleaned with wire brush.

Fix self-adhesive insulation fasteners (pins) of appropriate length on chiller body at regular interval of 250 mm at either side or max. 150mm from the end.

Apply generous layers of cold setting Pidilite SR 998 adhesive.

Insulation shall then be fixed in two layers, staggering the joints between the strips and sealing them with 3mm thick 50 mm wide polyethylene tap.

Insulation shall then be covered with 0.63mm; 19mm mesh wire netting which shall be fixed to the insulation tighten with GI lace wire along the length.

The final finish shall be 12mm sand cement plaster which shall be applied in two layers of 6mm each and travelled to a smooth round finish.

After the insulation is fixed on the head as specified, it shall then be covered with a properly shaped jacket of 0.80mm G.I. sheet.

INSULATION (OTHERS)

The expansion tank and chilled water pumps shall be insulated as mentioned above and finished with plaster excepting that the insulation of 20 mm shall be fixed in a double layer with staggered joints.

Part 3 – Execution

PIPING INSULATION (Under Ground)

PIPE

The pipe shall be MS ERW as specified in the Piping Section.

INSULATION

The pipe insulation shall be polyurethane foam with 36 kg/cu m minimum density, 90% minimum closed cell content, minimum compressive strength of 40 psi and initial thermal conductivity of 0.0154 Btu/hr.ft.⁰F. The insulation shall completely fill the annular space between the service pipe and jacket and shall be bonded to both, the service pipe & jacket.

The insulation (PUF) shall be provided to the minimum thickness with cladding of minimum thickness as specified below:

UNDER GROUND PIPING & INSULATION EXECUTION:

Underground systems shall be buried in a trench of not less than 600 mm deeper than the top of the pipe & not less than 450mm wider than the combined OD of all piping systems. A minimum thickness of 600mm of compacted backfill over the top of the pipe is desirable.

Trench bottom shall have a minimum of 150mm of sand, pea gravel or specified backfill material, consolidated to suit operating weight & to act as a cushion for the piping.

Buried piping:

The outer protective insulation jacket shall be seamless, extruded, black, uv resistant, high-density polyethylene (**HDPE**). The minimum thickness of the **HDPE** jacket and PUF shall be as follows:

MS Pipe dia. (mm)	PUF Thickness (mm)	Thickness of HDPE Cladding (mm)

20 mm	29	2.5
25 mm	36	2.5
32 mm	31	2.5
40 mm	36	2.5
50 mm	37	3.0
65 mm	39	3.0
80 mm	43	3.0
100 mm	40	3.2
125mm	39	3.5
150 mm	53	4.4
200 mm	63	5.0
250 mm	57	6.3
300 mm	58	7.0
350 mm	64	7.8
400 mm	68	8.8
450mm	77	9.8
500mm	50	11.1
550mm	65	11.1
600mm	83	12.5
650mm	58	12.5
700mm	82	13.0
750mm	104	15.0
800mm	79	15.0

However the exact thickness could vary marginally for underground piping based on the exact sizes of **HDPE** pipes available as per the chart given below:

FITINGS

Fitting can be fabricated at site over the carrier pipe and correct quantity of PUF shall be poured manually.

FIELD JOINTS INSULATION:

Field joints insulation shall consist of **PUF** poured manually in a site-fabricated.

Installation of Insulation With Cladding

- i. Follow the same procedure as mentioned above but with glass wool laminated with Kraft paper. (Applicable for Glass wool).
- ii. The insulated ducts shall be covered with wrapping of two layers of polythene vapour barrier of 500 G of virgin type of white colour with overlapping of longitudinal and transverse joints. Cover this with PVC strapping for keeping insulation in position.
- iii. Finish the surface with 24 G aluminium sheets of INDALCO/HINDALCO/ BALCO make fixed with the hand operated grooving M/C and anodised steel screw to get smooth finish surface.
- iv. Do not cover equipment nameplates with insulation.
- v. Coordinate related work with other Divisions.
- vi. Pump, valves, fittings and accessories in the chilled water circuit shall also be proper insulated by using either the same material as pre-insulated pipe or high density fibreglass. Galvanised external jacket with paint finish shall also be provided.

INSULATION (CHILLER)

Following procedure shall be followed for chiller insulation if required to be executed at site.

The chillier surface shall first be cleaned with wire brush.

Fix self-adhesive insulation fasteners (pins) of appropriate length on chiller body at regular interval of 250 mm at either side or max. 150mm from the end.

Apply generous layers of cold setting CPRX adhesive.

Insulation shall then be fixed in two layers, staggering the joints between the strips and sealing them with CPRX. 400 G polythene shall also be provided as vapour barrier.

Insulation shall then be covered with 0.63mm; 19mm mesh wire netting which shall be fixed to the insulation with brass 'U'nails.

The final finish shall be 12mm sand cement plaster which shall be applied in two layers of 6mm each and trowelled to a smooth round finish.

After the insulation is fixed on the head as specified, it shall then be covered with a properly shaped jacket of 0.80mm G.I. sheet.

INSULATION (OTHERS)

The expansion tank and chilled water pumps shall be insulated as specified in 3.5 and finished with plaster excepting that the insulation of 30 mm shall be fixed in a single layer.

Acoustic Lining Of Mechanical Rooms (AHU Rooms)

Glass Wool Acoustic Board

Density: 70 to 80 Kg/cu.m

Thickness: 25 mm

Lamination: One Side FSK & Other side Black Glass Cloth

Size: 1200mm x 600mm or 3M x 1.20 M

Please refer Annexure B for the datasheet of the product

Tender Specification:

Acoustic Board should be applied on AHU walls and ceiling to provide superior acoustic absorption.

The insulation should conform to non-combustibility, Class-P (not easily ignitable), Class 1 (surface spread of flame NIL), and Class 'O' rating as per BS 476 standards.

Installation guideline:

1. The surface shall be cleaned and friction fixed in 610mm X 610 mm frame of 25X25X18 mm made out of 22 G thick GI sheet U shaped channel or else it can installed on the wall with screw bit.
2. The Acoustic board should be placed in such a way that black glass cloth is visible from inside the AHU room. Complete as required and as per specifications.

EE. PRE-INSULATED DUCT WORK: - PRE-INSULATED ALUMINIUM POLYISOCYANURATE FOAM DUCTWORK FOR AC

Pre-insulated Ducting

Smart PIR Ducting system (Using Sandwiched Panels of Polyisocyanurate Foam between Aluminium Foils)

The duct shall be fabricated out of sandwiched panels made up of complete CFC & HCFC Free PolyIsocyanurate Rigid Foam between Aluminium Foils as per the parameters given below:-

Duct Materials Specifications

The duct shall be fabricated out of sandwiched panels made up of Embossed Aluminum foils (With Anti-microbial, Anti-fungal, Anti-corrosion, UV Protection coating) on both sides and in between sandwiched with PIR foam. Insulating foam material shall be Expanded Rigid Polyisocyanurate Foam having closed cell content not less than 90%, Non-Toxic, Non-Combustible, Zero Ozone Depletion, Low Global Warming Potential.

Physical Characteristics of the panels shall be as follows:

Thickness of Panels	For Air-conditioned Area		For Non Air-conditioned Area		For External Area Expose to Sun & water & In Shaft	
	20	MM	30	MM	30	MM
Thickness of Aluminium	80 - 80	Microns	80/80	Microns	80/200	Microns
Density of the Foam-Minimum	45	kg/m ³	45	kg/m ³	45	kg/m ³
Finishing of Aluminium	Embossed	Embossed	Embossed	Embossed	Embossed	Embossed

For Internal and External Ducting 20mm & 30mm Thick PIR Panels should be used Irrespective of Duct size & Internal Stiffener to be provided for all the ducts in size 1000mm & above.

Both sides of the Aluminium foils should act as vapour barrier.

Lag coating shall be applied for external duct (Exposed to Sun & Water)

The said Panel material should have following properties and should hold certification by competent authority:

- 1) Panel should have Certificate of Conformity for Fire.
- 2) Should be Class O certified.
- 3) It should be certified for 'for Class 'O' according to BS 476 Part 6& 7 by Authorized International Fire Testing Laboratories i.e. 'WARRINGTON FIRE LABORATORIES, UK & US
- 4) It should be certified for similar Fire properties by Authorized Indian fire test laboratories i.e. CBRI- Roorkee, TUV- Singapore, Warrington Fire Laboratories-UK & US, NTL-India, NZWTA-New Zealand
- 5) For Flame Spread Index it should be certified for Class "A" certification as per 'ASTM E84' by relevant international authorities
- 6) For Smoke Developed Index, it should be certified for Class "A" certification as per 'ASTM E84' and similar safety codes by relevant international authorities
- 7) Toxicity Index shall not exceed 5.7 according to 'NES 713' by international fire testing laboratories i.e. 'WARRINGTON FIRE LABORATORIES, UK
- 8) The Duct should comply with EN 13403 certification from Istituto Giordano.
- 9) Fire rating of 2 hours at 250°C by NTL, India
- 10) Panels should have NRC of 0.3 with TC.
- 11) The Panels should be GRIHA Certified.
- 12) The Panels should be Green Product Certified meeting requirement of GreenPro Certification.
- 13) The Panels should be Rodent Proof certified.

The Panel Manufacturer should additionally comply with following **Quality and Operational Standards** for not only panels but accessories also:

- 1) ISO 9001:2015 for Quality Management System
- 2) ISO 14001:2015 for Environmental Management System
- 3) ISO 45001:2018 for Occupational Health and Safety Management Systems

Pressure Range:

No relevant modification of insulation, chemical or physical characteristics of the panels to be measurable, when conveying air up to the pressure of 2000 Pascal for 20mm & 30mm thick panels.

Thermal insulation characteristics:

Thermal insulation characteristics shall be as follows:

- Physiologically and chemically inert and insoluble.
- Vermin proof.
- Fungus proof.
- Non-Metabolisable.
- Thermal Conductivity: 0.021 W/mK at Delta 30°C.
- Water Absorption shall be less than 0.03% by 24 hours immersion test.

Temperature Range:

No relevant reduction of insulation, chemical or physical characteristics of the panels to be measurable, when conveying air in the temperature range of -45°C to +150°C.

Warranty on Insulation Characteristics:

Original Panel Manufacturer should offer 12-years Warranty for the Insulation (Thermal Property) material Characteristics.

Duct Accessories:

All the duct accessories like duct jointing profiles, profile inserts, adhesives, sealants, tape, Special Tape, corner covers of profiles are to be used from the original Duct Panel Manufacturers only to achieve accuracy and best efficiency in construction of duct.

Duct Fabrication and Installation Standards:

The ducts shall be fabricated as per the drawing provided and should be supplied at site in Pre-Cut form (Cut on CNC Machine only) and should be boxed at site complete with all suitable joint fittings & profiles, inserts, using proper adhesive and sealing arrangements etc.

Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer – In – Charge.

Governing Standards:

Unless otherwise specified here, all duct work shall be provided with adequate pre-fabricated hangers or support and to prevent vibrations.

All ducts shall be supported from the ceiling/ slab/ Purlins by means of fully threaded GI rods of 6mm diameter, with suitable capacity GI Slotted Channel or through Wire Supporting Systems supplied by Manufacturer.

Installation Supervision:

Installation to be carried out by Manufacturer's trained Installation team and shall be Supervised & Certified by the Manufacturer's representative.

Joint System:

The joints between the ducts shall be using PPDE invisible flanges and slide-in-gasketed bayonet to be used and to be connected by special cover corners, having a 3 point holding pin, which goes inside the flange and the insulation, to avoid any field connection and to give the system more strength.

Ductwork shall be installed, using supports, as described in DW144 & according to manufacturer's requirements. Maximum distance between supports shall not exceed:

- 4000mm for ducts with section not exceeding 1200 x 1000mm.
- 2000mm for ducts with section exceeding 1200 x 1000mm.

All duct work shall be of high quality approved PIR Sheets guaranteed not to crack or peel on bending or fabrication of ducts. Care should be taken at site so that the Aluminum foil covering the panel is maintained intact during Installation to ensure Vapour Barrier continuity.

All joints shall be air tight and shall be made in the direction of air flow. All duct joints shall be inserted with exact size cut inserts to suit the profiles and corners should be covered with PVC corners.

For External Duct gasketed bayonet to be used between the joining profiles with special reinforced tape to cover on the joints.

Fixing of Pre-Insulated Ducts with various ducting items like Volume Control Dampers or Fire dampers etc. shall be done using Polymer Flanges of the desired type of manufacturer's make only.

Reinforcements:

Appropriate number of internal stiffeners of Threaded Rod, Nut and Bolt and load-distribution GI Discs for very large ducts are provided.

For positive pressure (supply ducts) and for negative pressure (return ducts) load distributing GI Discs are placed externally and internally for better strength.

Reinforcements will be fixed perpendicular to the larger duct dimension. These will be installed on ducts exceeding 1000 mm W/H any dimension, as per following spacing.

1200 – 1500 – 1 No x 1/2 – 1/2

1500 – 1800 – 2 Nos x 1/4 – 1/2 -1/4

1800 – 2100 – 3 Nos x 1/6 – 1/3 – 1/3 – 1/6

2100 – 2400 – 4 Nos x 1/8 – 1/4 – 1/4 – 1/4 – 1/8

However, as per site requirement and constraints, certain duct pieces can be fabricated and made at site using the same above standards to suit pieces.

Great care should be taken to ensure that the ducting work does not extend outside and beyond height limits as noted on the drawings.

The ducting work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the Engineer – In – Charge. The contractor shall verify all measurements at site and shall notify the Engineer – In – Charge. All duct measurements to be done on outer to outer size.

FF. PIPING AND FITTINGS

1. SCOPE

The scope of this section comprises the supply and laying of pipes required for chilled water; condenser water & drain water conforming to these specifications and in accordance with the requirement of the 'Technical Schedule of Equipments' and 'Schedule of Quantities'

2. WATER PIPING

i. MATERIAL

Water piping fittings and valves shall be of the following makes or approved equal make and shall conform to IS standards as indicated below.

a. Pipes

- i. UPTO150MM :- MS, Class C (Heavy Class) as per IS 1239 (Part I & II) 1990/1992
- ii. 200MM & ABOVE:- Welded Black Steel Pipe Class 2 (6.35 MM Thickness). As per IS 3589 (LATEST)

Grooved Couplings & Fittings shall be used to join pipes from 20 NB & Above. No Welding is allowed.

Pipe/Grooved: Carbon Steel / MS- Roll grooved-ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. The Grooving Machine used shall be of the same manufacturer as Grooved Couplings & Fittings. Groove Measuring Tape shall be used to check the Groove in the pipe.

Standard Mechanical Couplings

Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. (Gaskets used for potable water applications shall be UL classified in accordance with ANSI/NSF-61 for potable water service.) Mechanical Coupling bolts shall be zinc plated (ASTM B633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A- 183, minimum tensile strength 110,000 psi (758450 kPa). Grooved Couplings requiring Torque to tighten as a part of their installation shall not be allowed till 12".

Rigid Type 20 NB and above: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13.

- a. 2" (DN50) through 8" (DN200): Installation ready rigid coupling for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound with red color code designed for operating temperatures from 30 deg F (-34 deg C) to +250 deg F (+120 deg C)
- b. 10" (DN250) through 12" (DN300): Standard rigid coupling - Gasket shall be Grade "E" EPDM compound with green color code designed for operating temperatures from -30 deg F (-34 deg C) to +230 deg F (+110 deg C)

Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three couplings, for each connector, shall be placed in close proximity to the vibration source.

- a. 2" (DN50) through 8" (DN200): Installation ready flexible coupling for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C) -
- b. 10" (DN250) through 12" (DN300): Gasket shall be Grade "E" EPDM compound with green color code designed for operating temperatures from 30 deg F (-34 deg C) to +230 deg F (+110 deg C)

2. Flange Adapters: For use with grooved end pipe and fittings, flat faced, for mating to ANSI Class 125/ 150 flanges/ PN 10/ PN 16

3. Grooved couplings shall meet the requirements of ASTM F-1476.

4. Gasket: Synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D- 2000.

Grooved AGS Mechanical Couplings - 14 inch (DN350) & above: Couplings shall consist of two ASTM A-536 ductile iron housing segments, a wide elastomer pressure responsive gasket, and zinc electroplated carbon steel track head bolts and nuts conforming to the physical and chemical requirements of ASTM A-449 and the physical requirements of ASTM A-183.

a. Coupling housings designed with the wedge-shaped AGS key profile to engage the mating pipe(s)/component(s) wedge-shaped AGS grooves. Housings include lead-in chamfer to accommodate a wider range of initial pipe positions. Housings shall be coated with orange enamel

Grooved End Fittings: Standard fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, forged steel conforming to ASTM A-234, Grade WPB 0.375" wall (9,53 mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish. Zinc electroplated fittings and couplings conform to ASTM B633.

AGS Fittings shall be supplied with factory AGS grooved ends. Fittings shall be manufactured of ductile iron conforming to ASTM A-536, forged carbon steel conforming to ASTM A-234, or factory fabricated from carbon steel pipe conforming to ASTM A-53. Fittings shall be manufactured to the dimensional standards ASME B16.9. Orange enamel coated - for use with Grooved AGS Product

Hole-Cut Branch Outlets: Bolted Branch Outlet: Branch reductions on 2"(DN50) through 8"(DN200) header piping. Bolted branch outlets shall be manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with synthetic rubber gasket, and heat treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183 Installation Ready Couplings shall be installed directly in the pipe without disassembling the Gasket.

Grooved end product manufacturer to be ISO-9001 certified.

b. GATE & GLOBE VALVES

Make: As approved shall be heavy duty non rising spindles as per IS 780, 778 and flanges as per IS 1536 and factory tested for 10Kg/ sq cm test pressure.

c. BALANCING VALVES

The balancing valves control and shut off valves with built in pressure drop and flow measuring facility shall be provided in the water outlet pipes of condensers and chillers, AHUs or wherever shown in tender drawings. The valve shall have Oblique(Y-Type) Design for lower pressure drop and low Cavitations for Longer Valve Life;

- i. 15mm to 50mm Size: Cast Bronze (IS 318 GR. LTB2) Screwed ends
- ii. 65mm and above: Cast Iron (IS 210) with flanged ends

Balancing Disc Shall be of High Tensile Brass (BS2874 CZ114) / Cast Carbon Steel (ASTM A216 GR. WCB) with nickel Coating precision machined for Equal Percentage Flow Characteristics & Wide Rangeability. Stem shall be in Dezincification Resistant Brass (BS2874 CZ114). Valve should be Gland Less design with double EPDM O-Ring Stem Seals for life time maintenance free Sealing. Handle should be infinitely adjustable for easy and precise presetting with Concealed Memory feature for temper proof Operation. The Valve shall be supplied with Pressure & Temperature test plugs as standard. Paint should be 200+ micron thick Fusion Bonded Epoxy (Lead free) coating for much higher Corrosion & Erosion resistance.

To enable accurate and practical operation, measurement of flow and differential pressure shall be made with a computerized balancing instrument which shall enable the operator to read the flow directly without the use of diagrams or tables. In addition to measuring flow rate, differential pressure and temperature, computerized balancing instrument shall have a computer programs to provide the following functions:-

To balance the HVAC installation and calculate the necessary valve settings, based on system measurements.

To store the results of balancing.

To log measured values from a valve (differential pressure, flow rate or temperature)

To printout saved data in computerized measurement protocol (CMP) consisting of:-

- Name and size of Balancing Valve (BV)
- Presetting position of BV
- AP at BV
- Flow at BV
- Design Flow

Flanges shall be of approved make. The supply of flanges shall form part of piping (not separately identified in Schedule of Quantities) and shall also include supply of bolts, washers, nuts and suitable rubber insertion gaskets (minimum 3 mm thick).

d. BUTTERFLY VALVES

Butterfly valve shall be resilient seated, wafer type Semi Lugged design with pressure rating of PN 16. The valve shall have integral extended neck to accommodate min. 2" (50mm) of insulation. The body shall be Cast Iron (IS 210) with Epoxy coating (min. 200 microns) for adequate corrosion resistance. Disc shall be Black Epoxy coated Ductile Iron (ASTM A536). Valve Seat shall be Black Nitrile **vulcanized on a hard back up ring suitable for field replacement**. Stem shall be Stainless Steel Gr.410 (ASTM A276). Heavy Duty Square Grooved Disc/Stem Connection without any mechanical fastening. Shaft shall be supported with Self Lubricated Bearings to minimize torques and impact of line pressures. Butterfly valves should come with Self lubricated Sliding bearings. The valve shall be universal design for insertion between BS4504 PN10/16, ASME B16.5 #150 & BS10 Table D/E flanges. Mounting Flange as per ISO 5211. Valves shall be supplied with flow control lever with notches. Valves of size 250mm & above will be Heavy Duty Worm Gear Operated and to be supplied with factory machined companion flanges and fasteners. Paint should be 200+ micron thick Fusion Bonded Epoxy (Lead free) coating for much higher Corrosion & Erosion resistance.

e. Motorized butterfly valves

The butterfly valves should be as per same specifications as of Butterfly valves with pressure rating of PN 16.

Electric Actuator should be On/Off Type with Protection class - IP67 & Power Supply of 230V AC as standard; Inbuilt Double Limit Switches, Over-hot & Overload Protection Features. Actuator Body shall be made of ABS/Die Casting Aluminum Alloy & internals made of Antirust & Anti - Corrosion Stainless Steel.

Valve Body	
Type of Valve	Butterfly Valve
Body Material	Cast Iron or Ductile Iron Body
Disc Material	SS-304
Stem	SS-420
Liner Material	EPDM
Nominal Static Body	PN16
Rating Tightness	Bubble Tight
Medium Temperature	-10 deg C to 120 deg C
Pipe Connection	ISO7005-2
Actuator Type	Electric
Motor Supply	230 VAC, 50Hz/60Hz
Travel Angle	90 deg +/- 5 deg
Enclosure	IP67 Waterproof
Indicator	Continuous Position Indicator
Space Heater	15W 220V AntiCondensation
Stall Protection	Built-in thermal protection Cut off at 125 ± 5 Reset at 95 ± 5
Manual Override	By Handwheel, nonclutch design
Torque Limit Switches	2 Nos.
External Coating	Dry Aluminium Alloy in Painted Black

f. BALL VALVES

Ball Valve shall be resilient seated, Two Way On-Off type, Screwed Ends with pressure rating of PN 20. The body shall be **Forged Brass** (IS 6912) for adequate corrosion resistance. Ball shall be mirror Polished Chrome Plated Stainless Steel (ASTM A351). Valve Seat shall be EPDM + Pure PTFE (BS6564) suitable for Adequate Sealing. Stem shall be Stainless Steel (ASTM A276). Stem seals shall be EPDM. Heavy Duty Rectangle Grooved Ball/Stem connection without any mechanical fastening. End connection shall be suit one of the BS21BSP/BSPT, ASME B1.20 NPT & ISO228 Pipe Threads.

g. NON RETURN VALVES

Non return valves shall be dual plate check valve provided as shown on the Drawings, and identified in Schedule of Quantities conforming to relevant Codes and in accordance with the following Specifications.

Size	Construction	Ends
50mm and above	Body cast iron with 200+ micron thick Fusion Bonded Epoxy (Lead free) coating	Wafer

Disc shall be Black Epoxy coated Ductile Iron (ASTM A536). Valve Seat shall be Black Nitrile vulcanized on body suitable for Bubble Tight Sealing. Hinge Pin & Spring shall be Stainless Steel Gr.304 (ASTM A276). Valve Design shall be with true bore area relevant to the valve size. The valve shall be universal design for insertion between BS4504 PN10/16, ASME B16.5 #150 & BS10 Table D/E flanges.

h. STRAINERS

i. Strainers shall be 'Y' type or Pot type Strainers as shown on drawings and as per requirements. 'Y' Strainer shall be fabricated out of MS 'C' class pipe two sizes higher than that of Strainer pipe size. Flanges as per B.S. 10 shall be provided at inlet and outlet connectors. The body shall be pressure tested at 10 kg/cm² and shall be hot dip galvanized. Permanent magnet shall be provided in the body of the Strainer to arrest MS particles. Filter element shall be of non-magnetic 20 gauge SS sheet with 3 mm perforation. Strainers shall be provided at inlet of each Air Handling Unit and Pump as shown in drawings and as per requirements.

Pot Strainers body shall be fabricated out of MS plate IS 226. Thickness of sheet shall be as per size of the strainer chamfered pipes with flanges shall be provided at inlet/ outlet connections of the strainer. The tangential entry of water shall create a centrifugal action and due to velocity shall separate sediments and deposit on the inner surface of Filter Element and at bottom of the Strainer. Butterfly valves shall be provided at inlet/outlet connections as shown in drawing and as per requirements. The strainer body shall have two separate chambers properly sealed to avoid mixing of filtered and unfiltered water. A powerful magnet shall be provided in the body to arrest MS particles. Filter element of Pot Strainer shall be of non-magnetic 18 gauge SS sheet properly reinforced to avoid damage of the element. A cone with sufficiently to flush out foreign particles. This arrangement shall avoid frequent opening of Pot Strainer for cleaning of filter element. Gage connection shall be provided at inlet and outlet connection. A set of MS flanges with tongue and groove arrangement and neoprene rubber gasket shall be provided on the top cover and Pot Strainer flange with sufficient bolts and nuts to make the joint watertight. Bearing loaded top cover lifting and swinging arrangement shall be provided. The Pot strainer body shall be properly de-rusted and epoxy coated from inside and outside. Manufacturers Test Certificate shall be provided with each Pot Strainer.

Size of various Pot Strainer, Filter Element and Thickness of MS sheet shall be as detailed below:-

Size (mm)	Pot Dia. (mm)	Pot HT (mm)	Element Dia. (mm)	Element HT(mm)	MS Plate Thickness (mm)
50	300	400	200	240	6
80	350	450	250	250	6

100	450	500	300	280	6
125	500	600	330	340	8
150	540	700	360	390	8
200	610	815	400	470	8
250	800	955	550	510	8
300	1000	1105	750	580	8
350	1190	1300	895	678	12
400	1350	1500	1020	785	12
450	1518	1700	1060	890	12
500	1690	1800	1100	900	12
600	2000	2200	1500	1160	12

The Y-Strainer & Pot Strainer conforming to SSPL 107 & SSPL 106 shall have cast iron body and factory tested at works at 16 Kg/sq.cm pressure. The screen shall be made out of 3 mm perforated stainless steel sheet. It should be easily removable when required to be cleaned. Isolating butterfly valves at either end of the pot strainer shall be provided. Each pot strainer shall be provided with a Test Certificate.

- ii. All chilled water piping and fittings shall be pressure tested, painted and then insulated as described under the section "Insulation".

h. AUTO AIR VENT VALVES

- i. Air vent valves shall be provided at all higher points in piping system for venting and of following sizes:-
Up to 100 mm dia pipes: 25 mm dia.
- ii. Air vent valves shall be Gun metal and tested up to pressure of Class I pressure rating.

FITTINGS

The dimensions of the fittings shall conform to IS 1239/69 Part II (as per latest amendment) unless otherwise specified in specification.

All bends in sizes up to and including 150 mm dia shall be readymade of heavy-duty, wrought steel of appropriate class.

All fittings such as branches, reducers etc. in all sizes shall be fabricated from pipes of same dia and thickness and length at least twice the dia of pipe.

The branches may be welded straight to main line.

Blank ends are to be formed with flanged joints and 1 mm thick blank insertion of rubber gasket between flange pair for 150 mm and over in case where a future extension is to be made otherwise blank end discs of 6 mm thickness are to be welded on with additional cross stiffeners.

The tender drawings show schematically the size and location of pipes but this is for contractor's guidance only. Pipe runs may be changed to meet the site conditions.

3. PIPING INSTALLATION

- a. All piping work shall be carried out in workman like manner causing minimum disturbance to the existing services.
- b. Piping shall be of steel, primer coated with rust preventive paint and finished with approved shade. Pipe supports shall not exceed the following spacing: -

MAXIMUM SPACING OF PIPE SUPPORTS

Pipe Size (MM)	Spacing (Mtr.)	Rod Size
25	2	10 mm
30 to 75	2.5	10 mm

100 and above	3.0	12.5 mm
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Pipe hangers shall be fixed on walls and ceiling by means of metallic Raw bolts or approved shear fasteners.

- c. Piping shall be properly supported on, or suspended from, stands, clamps, and hangers as specified and as required. The contractor shall adequately design all the brackets, saddle, anchors, clamps and hangers and be responsible for their structural sufficiency.
- d. Vertical risers shall be parallel to walls and columns. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 10 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall also have a duck foot elbow or steel support welded to the pipe at the lowest point. On risers drain valves shall be provided at heels.
- e. Pipe sleeve of 50 mm larger than the pipe diameter shall be provided wherever pipes pass through walls and the annular space filled with felt and finished with retaining rings. In case of an insulated pipe the diameter shall be inclusive of insulation.
- f. Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. Metal sheet shall be provided between the insulation and clamp, saddle or roller extending at least 150 mm on both sides of clamp, saddle or roller.
- i. **PRESSURE GAUGES AND THERMOMETERS**
 - a. One pressure gauge each shall be provided to measure pressure at the inlet and outlet of each cooling coil, shall be not less than 100 mm Dia and shall be complete with shut off (globe) valve. Care shall be taken to protect pressure gauge during pressure testing, range shall not exceed 50% above normal measurement.
 - b. Thermometer shall be stem type and shall be provided at inlet and outlet of each cooling coil.

4. TESTING

- a. All water piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure but not less than 10 kg/sq cm for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the AAHII.
- b. Pipes repaired subsequent to above pressure shall be retested in same manner.
- c. Piping may be tested in section and such sections shall be securely capped.
- d. The Contractor shall ensure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipments in the system concerned. If proper circulation is not achieved due to air bound connections, the 'Contractor' shall rectify the defective connections. He shall bear all the expenses for carrying out above rectifications involving tearing up and refinishing of floor walls etc. as required.
- e. The Contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by Engineer-In-Charge at site.
- f. The contractor shall provide temporary pipe connections to initially by-pass condenser/chiller and circulate water through condenser/ chilled water pipe lines for minimum 8 hours. Water should be drained out from the lowest point. The temporary lines shall be removed and blanked with dead flanges. Pot strainers and Y strainers shall be cleaned and fresh water filled in the circuits.
- g. After the piping has been installed, tested and run for at least three days of eight hours each, all un-insulated exposed piping in plant room shall be given two finish coats, 3 mills each of approved colour, conforming to relevant BIS Codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows. For painting of insulated and clad pipes refer to insulation section.
- h. After testing, all systems shall be chemically cleaned. After cleaning, the pipe work should be rinsed multiples times until the system is neutral. The contractor shall make a report conforming the above to Engineer-In-Charge for records.
- i. The Contractor shall provide all materials tools equipments, services and labour required to perform the test and to remove water resulting from cleaning and testing.

5. BALANCING

- a. After completion of the installation, all water systems shall be adjusted and balanced to deliver water quantities as specified.
- b. Instruments required for the water balancing (computerized balancing instrument) shall be accurately calibrated in an approved manner before taking any measurements. Calibrated

orifices and portable flow meters shall be used to balance the water flow. Orifices used for testing and balancing shall be installed with straight length up stream and down stream as recommended by the manufactures and shall be left permanently installed in the system.

- c. Automatic control valve and three way valves shall be set for full flow conditions during balance by procedure. Water circuit shall be adjustable by balancing cocks provided for balancing. These shall be permanently marked after balancing is completed so that they can be restored to their correct positions of disturbed.

6. PAINTING

In case of pipes to be insulated after thorough anti grease and rust removal treatment, clean the pipe and then apply two coats of epoxy primer before applying in insulation treatment as specified elsewhere. All uninsulated pipes after de rusting will be provided with two coats of epoxy primer followed by epoxy paint of approved shade.

i. FIRE BREAKS INSULATION

Firebreaks shall be provided in all ducts for internal lining/external thermal insulation after a run of 10 m center to center. There shall be a discontinuity of the insulating material in the form of MS angle of a minimum of 50 mm x 50 mm x 3 mm size. At the interface of the MS angle and insulating material, proper care of tucking in of the insulating material shall be taken so as to prevent erosion.

GG. REFRIGERANT PIPING

1.0 Scope of Work

The scope of this section comprises supply, installation, testing & commissioning of refrigerant piping as detailed below in specifications.

2.0 Refrigerant Piping

All refrigerant piping for the air conditioning system shall be constructed from soft seamless up to 19.1mm and hard drawn copper refrigerant pipes for above 19.1mm with copper fittings and silver-soldered joints. The refrigerant piping arrangements shall be in accordance with good practice within the air conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.

All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. Before joining any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 20Kg per sq.cm and 10 Kg per sq.cm (low side). Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum if 700mm hg and held for 24 hours.

The air-conditioning system supplier shall be design sizes and erect proper interconnections of the complete refrigerant circuit.

The thickness of copper piping shall not be less than 20gauge for pipes up to 19.1mm and 18 gauge for bigger sizes.

S. No.	Sizes Diameter (mm)
a)	6.4 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
b)	9.5 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
c)	12.7 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
d)	15.86 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
e)	19 mm dia (OD) (Hard drawn) with tube thickness 1.2 mm with 19 mm thick insulation
f)	22.2 mm dia (OD) (Hard drawn) with tube thickness 1.2 mm with 19 mm thick insulation
g)	28.58 mm dia (OD) (Hard drawn) with tube thickness 1.2 mm with 19 mm thick insulation
h)	34.9 mm dia (OD) (Hard drawn) with tube thickness 1.62 mm with 19 mm thick insulation
i)	41.27 mm dia (OD) (Hard drawn) with tube thickness 1.62 mm with 19 mm thick insulation
j)	6.4 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
k)	9.5 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
l)	12.7 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation

The suction line pipe size and the liquid line pipe size shall be selected according to the manufacturers specified outside diameter. All refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports which

shall be fixed to the building structure by means of inserts or expansion shields of adequate size and number to support the load imposed thereon. All interconnecting piping, joints and U bends shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air pollution.

The OD & wall thickness size of copper refrigerant piping shall be as per VRV/ VRF manufacturer standard. The pipe thicknesses given above table are minimum.

HH. INSULATION PROTECTION & ADHESIVE

Recommended Adhesive

- High Bond Strength adhesive for installing all flexible insulation materials. Adhesive shall be used for bonding the seams securely together. All butt & longitudinal joints, fittings and coverings must be closed with adhesive
- The adhesive shall be synthetic in nature, free from benzene and shall be complying to the Green Building Norms. Certificate of compliance shall be supplied by Adhesive manufacturer only. In case the adhesive is supplied by a dealer/ third party manufactured, certificate from the manufacturer only will be accepted.
- The adhesive shall have excellent bonding to porous and non-porous surfaces and shall not have any pungent odours.
- The adhesive has to be applied with the help of brush only.
- Suggested product AC Duct King Echo Fresh/ equivalent

Technical Details

Solvent Based Rubber contact adhesive

Temperature Range: -20°C to +96°C

Form: Liquid

Material: Chloroprene Rubber based synthetic adhesive

Minimum Drying Time (airing time): 3-4 Minutes

Setting Time: 24 hours

Viscosity @ 30°C: 1000 - 2500 cps

Specific Gravity: 0.75 - 0.90

Flash Point:> -20°C

Coverage: 5-6 square meters per litre per coat

Tack Retention Time: 20 minutes

VOC : Less than 700 gms / litre

"Protective Covering for Pipe Insulation in Internal and External Areas".

1.1 Internal Piping Insulation Protection

All internal insulated pipes shall be coated with two protective coats each of 500 micron (0.5 mm) WFT Fire Retardant coating conforming to UL 723 Class A and ASTM 4804 and having Anti Fungal and Anti-Bacterial properties conforming ASTM D 5590, sandwiched with 7 Mil Class E Glass Cloth with relevant colors.

Manufacturer shall submit test certificate of conformity for above all parameter issued by internationally recognized Independent Laboratory should be submitted along with type test report.

1.2 Piping Insulation Protection

All longitudinal and transverse joints shall be sealed as per coating manufacturer recommendations. The adhesive shall be strictly as recommended in the above section.

All insulated external chilled water and refrigerant pipes shall be coated with external grade coating with each of 500 micron (0.5 mm) WFT, weathering Resistant coating conforming ASTM 6695 and having excellent Rain Water Resistance, high level water permeability resistance and must be Anti Fungal and Anti Mold (both properties), conforming to relevant internationally acclaimed standards such as ASTM D 6904, ASTM D 2842, ASTM D 5590 and ASTM D 5589. The coating has to conform to ASTM E 96 for water vapor permeability. Coatings conforming to with Fire resistant properties such ASTM 4804 and ASTM E 84 shall be preferred. The Two coats shall be sandwiched between 10 Mil Class E Fibre Glass Cloth. Glass Cloth Tape of 10 Mil Class E can also be used.

Coating Manufacturer shall submit test certificate of conformity for above all parameter issued by internationally recognized Independent Laboratory should be submitted along with type test report.

II. DUCT SUPPORTING SYSTEM

Wire Hangers shall be used to suspend all static HVAC Air Distribution services.

Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10) stud, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturers recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a self-locking lockat the other end with double channel locking arrangement. Once the lock is engaged, for safety purpose, unlocking should only be done by using a separate setting key and should not be an integral part of the self-locking grip. . In case unlocking arrangement is an integral part ie. button/pin type, the button/pin shall be hidden under a separate housing cover made of same material as of housing. To guard against accidental unlocking, the unlocking button/pin should be accessible if and only if the housing cover is removed. Only wire and/or supports supplied and/or approved, shall be used with the system.

Support of duct (for MRI, CT Scan, X-Ray, radiology areas) shall be of non-magnetic material like aluminum designed to take the required load of services where supports and clamps are of dissimilar materials, a gasket shall be provided in between. Any material being used shall be non-magnetic in nature and should be suitable for clean room application.

- a. Wire Hangers should have been independently tested by Lloyds Register. APAVE, TUV, CSA, ADCAS, , ECA approved by CSA and comply with the requirements of DW/144 and BSRIA – wire Rope Suspension systems. Wire rope should be manufactured to BSEN 12385: 2002 standards.
- b. Wire Hangers shall be independently tested by reputed third party testing organization to sustain safe working load for 120 minutes at elevated temperature of 175 deg. C or above.
- c. The contractor shall select the correct specification of wire hanger to use for supporting each particular service. Each size should be designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).

The correct specification of wire hanger required should be determined using the following formula or as per manufacturer’s recommendation, whichever is stringent.

Weight per meter of object suspended (kg) X distance between suspension points (m) = weight loading per Hanger suspension point (kg).

Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations give in the manufacturer’s handbook.

The contractor shall select the correct length of wire rope required to support the service. The contractor shall select the correct length of wire rope required to support the service. No in-line joints should be made in the rope.

The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless steel wire rope as per the application, the minimum specification is as above and should be manufactured to BS 302 (1987), BSEN12385. **Comply with manufacturer's load ratings and recommended installation procedures.** Note the testing is done to the minimum breaking load of the wire thus giving a minimum safety factor of 5: 1.

HVAC Supports – Wire Rope Hanger Supports are suitable for: Rectangular duct, Spiral Duct, Oval Duct, Fabric Duct, Desertification fans, Air Conditioning Units, Plenum Boxes, Radiant Panels, Heaters, Fan Coil Units, Diffusers and Chilled Beams.

a. Standard Ducting Supports:

Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Construction manager/consultant. In no case shall any duct be supported from false ceiling Hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other Contractor's work in the building.

b. Special Supports:

Refer to manufacturer's recommendations on Catenary supports, special care should be taken with tensioning of the wire and angles at which the installation of services are made. Stainless Steel Supports should be available for food, chemical and High Corrosion areas near coastlines.

Refer to manufacturers catalogue and installation guide for further technical information. **Comply with manufacturer's load ratings and recommended installation procedures.**

Notes: All supports are considered at 2400 mm interval and may vary as per the design but should not be greater than 2400mm.

Desertification fans, Air Conditioning Units, Plenum Boxes, Radiant Panels, Heaters, Fan Coil Units, Diffusers, Cassette units and Chilled Beams.

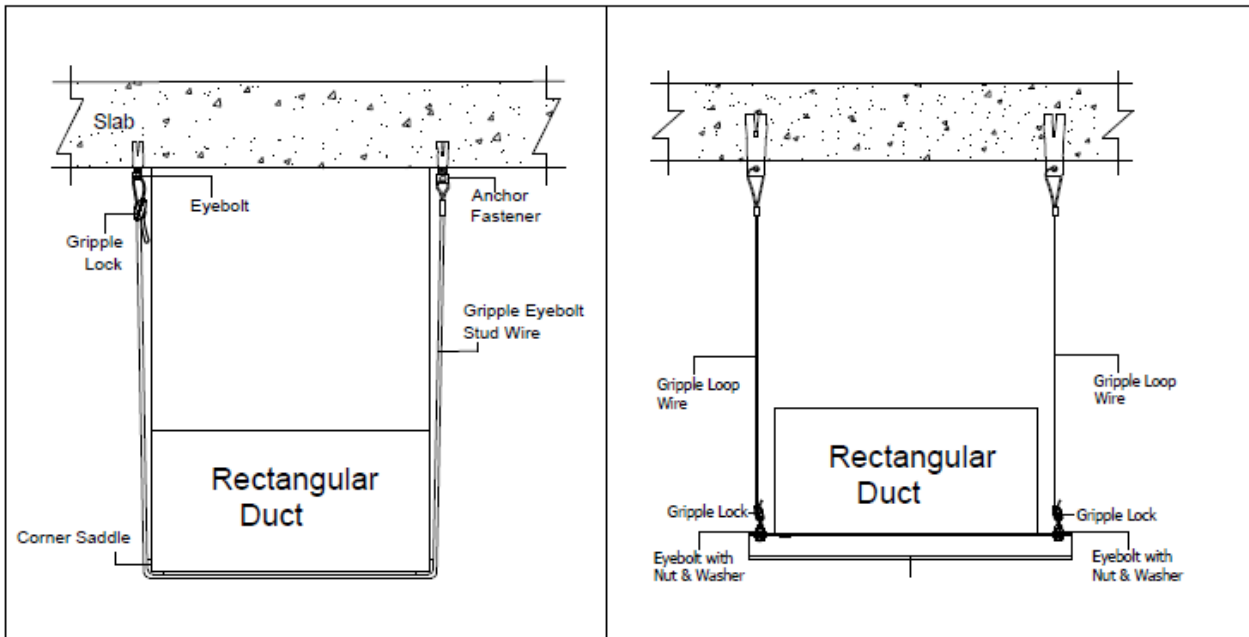
All units shall be adequately secured and supported in an approved manner using wire hanger suspension Y fit solution as per manufacturers' recommendation with prior approval.

Rigid Supports:

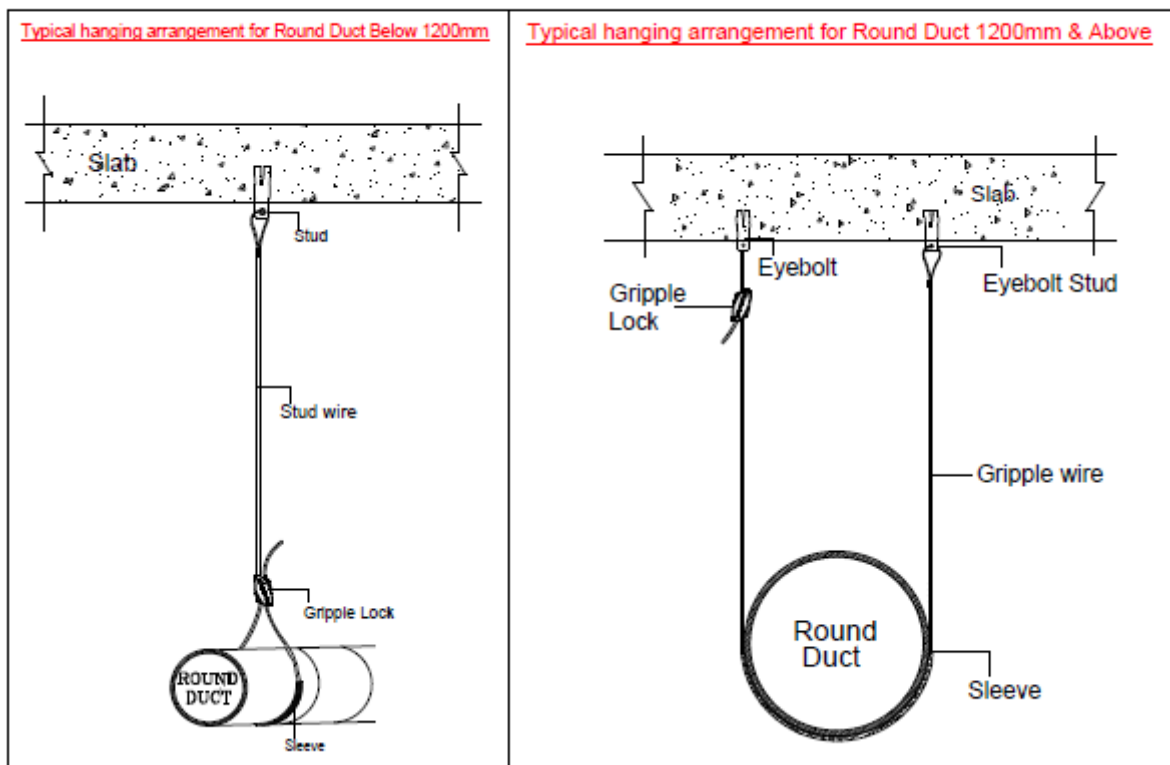
Rigid supports if required in conjunction with wire hangers, as per manufacturer recommendation, shall be of steel, adjustable for height and Zinc chromate primer coated and finish coated black, Galvanized Strut support system of required strength and profile can also be used. Where supports and clamps are of dissimilar materials, a gasket shall be provided in between.

c. **Typical Arrangement for Duct Supports from RCC slab**

Typical Arrangement Rectangular Duct for Slab Area

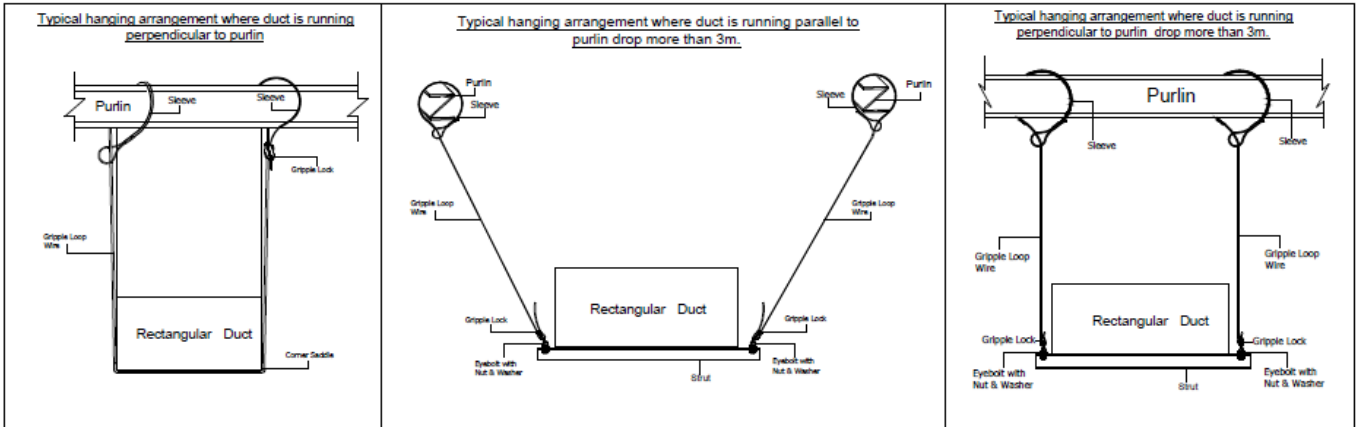


Typical Arrangement Round Duct for Slab Area

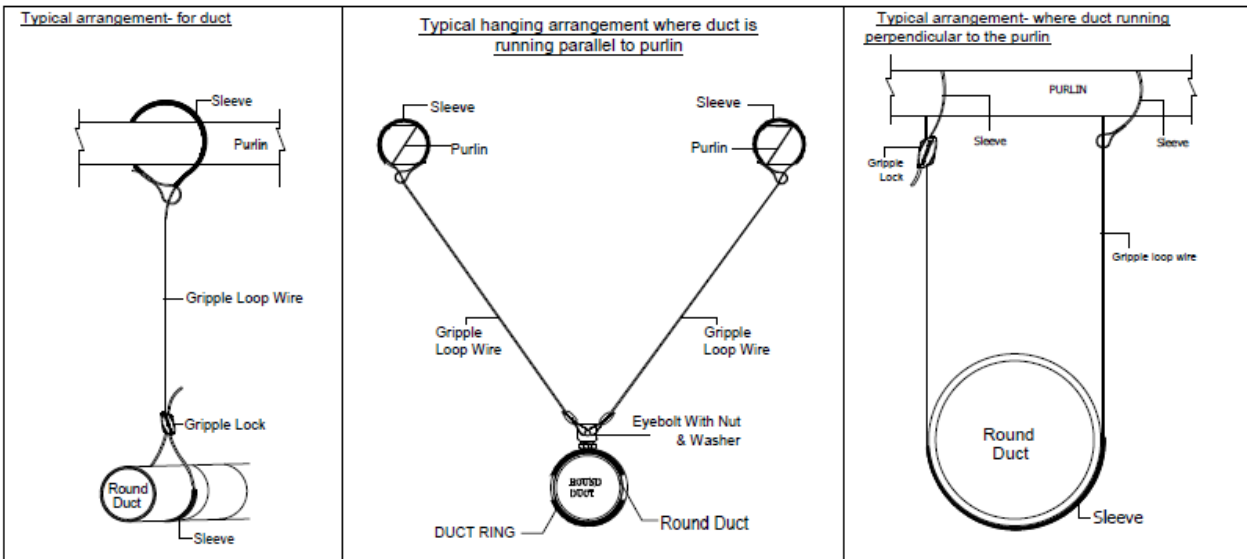


i. Typical Arrangement for Duct Supports from PEB

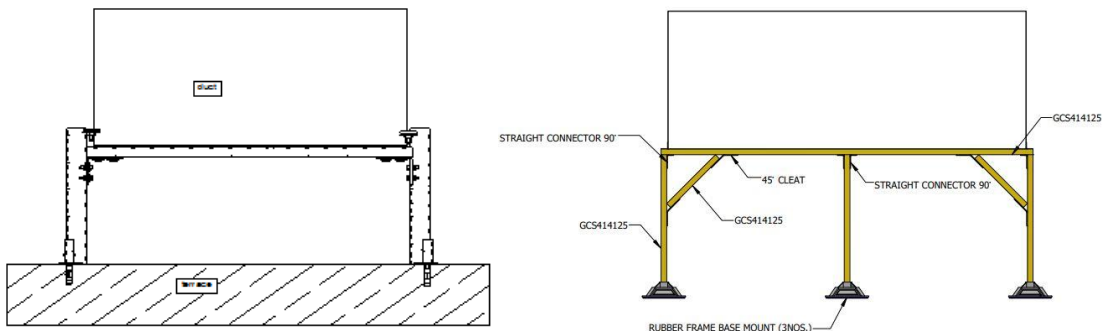
Typical Arrangement Rectangular Duct for Structure Area



Typical Arrangement Round duct for Structure Area



ii. Typical Arrangement for Duct Support on terrace:



Note: Foot based supports should be used for terrace/floor application to avoid anchorage/drilling on terrace/floor.

JJ. SEISMIC RESTRAINTS & SEISMIC VIBRATION ISOLATION FOR NON-STRUCTURAL COMPONENTS FOR MEP

1.0 INTRODUCTION:

This specification is intended to provide general guidelines for the Seismic Analysis of Non-Structural components ie. MEP & FF distribution & equipments

2.0 SCOPE:

Seismic Analysis/Calculations should be carried out based on IS16700:2017. References from IS16700:2017 should be taken for seismic forces. Exceptions for Seismic supports as stated in ASCE7 seismic restraint manual should be considered. For Fire-fighting distribution components & equipment sway bracing design and exceptions mentioned in NFPA 13 will supersede exceptions mentioned in ASCE 7.

3.0 DESIGN LOADS:

3.1. DEAD LOADS

The dead load is assessed based on the weight of the equipment/distribution system.

3.2. SUPERIMPOSED DEAD LOAD

The super imposed dead load is assessed based on the weight of the equipment / distribution system. For pipes containing water, weight of the water filled pipe is included in this load case.

3.3. EARTHQUAKE LOAD

Earthquake load should be calculated as per IS16700:2017, appropriate references from ASCE 7-10 should be considered

As per IS16700:2017/NBC 2016, following parameters should be considered

1. Seismic zone should as per NBC 2106 Part 6 Section 1 or as per building design seismic zone factor.
2. Seismic zone factor, Z - , as per NBC 2016 Part 6 Section 1 Table 42 Clause 5.3.4.2.
3. Seismic Design Force is calculated as IS16700:2017, as follows

$$F_p = Z * (1+x/h) (a_p * I_p/R_p) W_p \geq 0.10 W_p \text{ (As per IS16700:2017)}$$

where,

Z = seismic zone factor given in NBC 2016 Table 42 (Clause 5.3.4.2) should be considered.

- a.) Zone factor for some important towns are given at NBC 2016 Part 6 Section 1 Annexure K or as per building design seismic zone factor
- b.) Response Reduction Factor should be taken as per IS16700:2017.
- c.) Amplification factor (as per IS16700:2017)
- d.) Importance factor, I_p (as per IS16700:2017)
- e.) z - Height in structure of point of attachment of component with respect to the base.
- f.) h - Average roof height of structure with respect to the base

Linear static analysis is considered for gravity loads. Equivalent static method is considered for Earthquake loads.

3.4 WIND LOAD ANALYSIS:

Calculate static and dynamic loading due to wind forces required to select/design vibration isolators, bases and seismic & wind restraints for outdoor & roof top equipments/services. The calculation of wind load shall be as per IS:875(Part 3)/NBC 2016 Part 6 Section 1. Worst case

between Seismic Loads and Wind Loads has to be considered for supporting and vibration isolation.

4.0 ANALYSIS METHOD

Linear static analysis is considered for gravity loads. Equivalent static method is considered for Earthquake loads.

5.0 DESIGN METHODOLOGY

The supporting structural steel system shall be designed according to Limit state method as specified in IS: 800-2007. Appropriate loads and its combinations, as per relevant clauses in IS codes should be chosen for design. Based on selection location and type of seismic support for the same shall be provided in the shop drawings.

6.0 LOAD COMBINATION

The various loads are combined in accordance with the stipulations in NBC2016. Load combinations considered in design are as follows,

Type	Load Case	Load Details
Primary	1	Dead Load-DL
Primary	2	Superimposed dead Load at Terrace- SIDL
Primary	3	Earthquake Load along X-Direction EQ(+X)
Primary	4	Earthquake Load along Z-Direction EQ(+Z)
Primary	5	Earthquake Load along Y-Direction EQ(+Y)

6.1 LOAD FACTOR FOR LOAD AND RESISTANCE FACTORED DESIGN (LRFD):

0.9 DL ± 1.5 (Eqx ± 0.3 Eqy) NBC2016 5.3.3.4

7.0 MATERIALS:

7.1 Structural Steel:

Materials	Standards
Hot-Rolled Members	
ISMC Channels	IS:2062
Angles	IS: 2062
Bolts & Nuts	Grade 4.6
Anchor fasteners	Grade 8.8
Cold-Formed Members	IS:811

7.2 Seismic Wire Rope Kit:

Wire based seismic restraint kits shall consist of Break strength certified, pre-stretched seismic cable with a permanently fixed 45 degree eyelet or ferruled copper/copper plated loop fixed to single, double or retrofit seismic bracket, or any other end fixture type or size as per manufacturers recommendation and design. The end fixing, bracket and wire must be of the same manufacturer. The system should be secured and tensioned with a Seismic rated self-locking grip at the other end. For ease of installation, flexibility, and workmanship only wire based seismic restraint system shall be used to restraint/brace all services.

Wire seismic restraints supplied and/or approved, shall be used with the system, the wire rope should not have color coding applied to it and should only be supplied with separate color coded tags. Bracing elements shall be seismic certified/tested by third party accredited lab as per ASHRAE standard 171, Method of Testing for Rating Seismic and Wind Restraints.

Cables shall have color coded size identifiers as per seismic requirements and must be pre-stretched. Cables shall be suspended 45 degrees (+/- 15 degrees Engineers allowances). Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key and unlocking button should not be an integral part of the self-locking grip for safety purpose.

At the point of the seismic restraint installation, a rigid support is required (threaded rod + rod stiffener or appropriate as approved by a qualified engineer). The location of all the seismic restraint points shall be determined by a qualified engineer.

When attaching the seismic restraints to the slab/structure seismic rated anchor shall be used. The connection of channel/ stiffener to the concrete should be done using anchors with ETA C2 approval for seismic loads. The design of anchors should be done as per ETA-TR 045 guidelines for seismic anchor design.

The seismic product to be used shall be determined by a qualified engineer, based on data supplied by the manufacturer.

The contractor shall select the seismic bracket for the attachment to the 'service' as either a standard or retrofit bracket. All parts and materials shall have been fully tested to conform to local/ state/provincial requirements and codes. The same manufacturer shall supply all parts and materials

The designer/contractor shall select the correct specification of wire based seismic restraints to use for restraining/bracing particular service mentioned in this specification; approved concrete anchors must be used by the designer/contractor. Refer to Table 1 below.

The Seismic engineer shall select the correct length of wire rope required to restrain/brace the various services & applications. No in-line joints should be made in the rope.

Table 1:

Wire based seismic restraint Safe Working Loads	
Kit Type	Design Strength (LRFD) (kg)
Type 2	239
Type 3	522
Type 4	1261

All Seismic restraints must comply with manufacturer's load ratings and recommended installation procedures.

7.3 Threaded Rod:

Size	Threaded Rod Diameter (mm)	Allowable Working Load (kN)	Allowable Working Load (kgs)	Max Unbraced Rod Length (mm) Table 7-5 ASHRAE Seismic Manual
M10	10	2.7	275.23	457
M12	12	5	509.68	635
M 16	16	8	815.5	584
M 20	20	12	1223.24	610
M 22	22	16.7	1702.34	660

7.4 Rod Stiffeners:

Rod stiffener consisting of steel channel and attachment clips capable of bracing vertical suspension rods or made out of Polypropylene to avoid potential buckling due to vertical compression forces should be used. Braces shall be selected to be of sufficient strength to prevent support rod buckling. Brace shall be attached to the vertical suspension rod by a series of attachment clips.

7.5 Riser Guides:

Risers shall be restrained against excessive lateral movement during service/earthquake. Riser guides must allow axial motion of the pipe and provide lateral restraint against static, hydrostatic & earthquake loads. The guides should include a neoprene bushing. This bushing allows some flexibility and prevents short-circuiting of vibration isolated device. The neoprene bushing also allows seismic loads to be cushioned and distributed to several guides.

7.6 Riser Anchors:

Straight solid risers can be rigidly anchored at one point provided the load is not concentrated on one floor. Riser anchors must be able to restraint against static, hydrostatic & earthquake loads. Riser anchor should restraint against excessive movement during services and earthquake thrusts by the use of 3-axis resilient anchors designed to withstand the required installation, operating and earthquake loads. Anchors shall be of steel construction and shall be attached to the riser with either a heavy-duty riser clamp or a welded support bracket in a manner consistent with anticipated design load. Snubbers shall limit lateral and vertical riser movements at each anchor location to a maximum of ¼" (6mm) in any direction. Anchors shall include a minimum of ½" (13mm) thick resilient neoprene pad to cushion any impact and avoid any potential metal-to-metal contact. Anchors shall be capable of withstanding an externally applied force of up to their rated capacity in any direction.

7.7 Riser Clamps

Riser clamps should be two-piece heavy-duty clamps bolted together and have a load rating based on clamping capacity. Riser clamps reinforce the pipe and distribute forces evenly to minimize pipe wall stress concentrations that would otherwise develop with welded lugs or brackets. The clamp must be sized for two times the dead load and there must be a positive means of engagement between the clamp and riser

7.8 All Directional Seismic Restraint Spring Mounts

Spring isolators shall be single or multiple coil spring elements which have all of the characteristics of free-standing coil spring, incorporating lateral and vertically restrained seismic housing assemblies. Restraint housing shall be sized to meet or exceed the force requirements of the application and shall have the capability of accepting coil springs of various sizes, capacities, and deflections as required to meet the required isolation criteria. All spring forces shall be contained within the coil/housing assembly, and the restraint anchoring hardware shall not be exposed to spring generated forces under conditions of no seismic force. Spring element should have built-in levelling adjustment and shall be accessible from above and suitable for use with a conventional, pneumatic or electric impact wrench. Restraint element shall incorporate a steel housing with elastomeric elements at all dynamic contact points. Elastomeric elements shall be replaceable. Restraint shall allow ¼" (6 mm) free motion in any direction from the neutral position. Isolators should have a min. operating Kx/Ky ratio of 1.0, springs should have 50% additional travel to solid beyond rated load. Isolators should be selected in the range of -30% to +25% of rated load. All isolators certified to withstand minimum 1.0 G force. Seismic 'G' ratings for all seismic restraint products should be 3rd party certified and should be part of relevant submittal. Spring elements should be color-coded for easy field verification and should be capable handling high deflection and should have a low natural frequency.

7.9 Modular Support Components:

C-channel vertical suspension shall be selected to be of sufficient strength to prevent support buckling. Wire rope brace shall be attached to the connector connecting vertical suspension C-channel/threaded rod/stiffener with horizontal C-channel by a suitable connector capable of taking seismic loads. Stress analysis calculation should be submitted for the worst-case length of the C-Channel/Strut members used. Stress analysis should be done for tensile, compressive and combined stresses.

The connection of wire rope bracing /channel/ threaded rod to the concrete should be done using anchors with ETA C2 approval for seismic loads. The design of anchors should be done as per ETA-TR 045 guidelines for seismic anchor design.

7.10 Flexible Connections/bellows for accommodation of differential seismic motion:

Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement. Install flexible connectors where adjacent sections or branches are supported/connected by different structural/non-structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural/non-structural element from the one supporting the connections as they approach equipment. All installed bellows and flexible connections shall be designed to accommodate for seismic motion and deflection.

8.0 SERVICABILITY REQUIREMENTS:

8.1 Deflection:

Deflection Limitations shall be as per 5.6.1 Table 6 of IS800:2007

10. Seismic bracing Design:

Seismic Supporting system shall be analyzed for seismic forces as per IS 16700 Cl. 10.2 and design intent seismic restraint manual - Guidelines for Mechanical system; ASCE 7-10 Chapter 13 and ASHRAE Practical Guide to Seismic Restraint shall be used as a reference for design basis & exceptions. The load calculations, stress calculations, design basis and exceptions considered shall be part of submittal for approval.

10.1 Project Design Criteria:

To be mentioned in the submittal documents:

Description	Standard
Seismic Zone	IS16700:2017
Seismic Zone factor	NBC 2016 Table 42 (Clause 5.3.4.2) or as per building seismic zone factor.
Soil Site class	as per site location
Importance Factor (Ip)	IS16700:2017
Component amplification factor (ap)	IS16700:2017
Component response modification factor (Rp)	IS16700:2017
Component response modification factor (Rp) for base isolation	IS16700:2017
Height in structure of point of attachment of component with respect to the base (z)	As per level of attachment of component
Average roof height of structure with respect to the base (h)	As per level of attachment at the roof/slab/peb level
z/h	ratio based on above parameters

For Calculations:

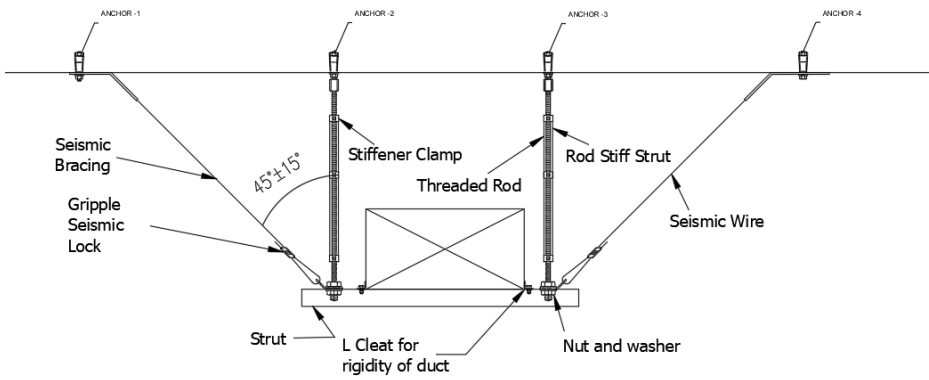
Description	Formula & Values
Seismic Design force In horizontal direction (Fp')	to be part of submittal
Vertical seismic force (Eqy')	to be part of submittal

Maximum Distance between Bracing for Ducts:

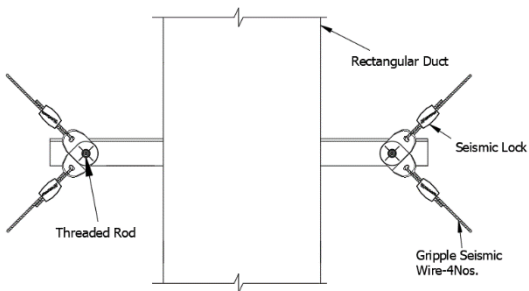
Maximum Seismic Acceleration Input (g)	Maximum Transverse Brace Spacing, ft (m)	Maximum Longitudinal Brace Spacing, ft (m)
0.25	40 (12.2)	80 (24.4)
0.50	30 (9.1)	60 (18.2)
1.0	30 (9.1)	60 (18.2)
2.0	20 (6.1)	40 (12.2)

Typical arrangements for seismic supports:

Two Way Bracing:



Four Way Bracing:



KK. IN-DUCT UVC AIR IRRADIATION (For all critical areas AHUs)

- UVGI system shall be designed for effective disinfection and provide a UV dose of greater than 3,000 $\mu\text{J}/\text{cm}^2$ in a single pass to achieve kill rate at least 99.9% (log 3) of virus/bacteria susceptible to this dose.
- The UV-C should be of 254 nm wavelength and no ozone shall be produced as a by-product.
- The power source shall be available in 230V AC 50 Hz. and be able to operate reliably in indoor environments ranging from 4°C to 40°C temperature, with relative humidity up to 100%.
- The lamps should be of High Output type (800 mA each). These lamps should be specially designed to be used in low temperature applications and shall provide a rated average life of 16,000 hours.
- The UV-C lamp shall be internally coated to reduce solarisation and of such intensity as to provide minimum performance as listed below.
- The fixtures shall be non-corrosive hardware so that the fixture does not vibrate or loosen. Safety interlock switches are to be installed on all access doors where UV intensity may be present.
- Length of each lamp used in the germicidal system shall be adequately long to cover the duct width. Alternatively the emitters may be installed parallel to the airstream creating a high intensity kill zone within the duct.
- The vendor shall supply the test certificate for each unit showing conformance to the technical specifications.
- The MOC of each lamp should be High Purity Fused Quartz or as per OEM standard.
- As it is a critical system hence AHU OEM's or any other system supplier's/ Contractor's shall not supply, install and commission the UVGI system to ensure accurate installation the UVGI system shall supplied, installed and commissioned by either OEM itself or its authorized system integrator only. Only project specific authorization letter shall be acceptable.

LL. COIL MOUNTED UV-C IRRADIATION SPECIFICATIONS (For All AHUs)

1. UV-Lamps increases Indoor Air Quality and comfort. UV-Lamps section should have a modular system that can be mounted by itself or combined with other modules side-by-side, overlapping, etc.; it must purify homogeneously the surface of the coil, eliminating the microbial load and the spreading and distribution of dangerous and annoying pathogens inside air handling units which other ways as the result of microorganisms combination and favourable conditions for their proliferation, such as temperature changes, high humidity and darkness.
2. UVGI system shall be designed for effective disinfection and provide a UV dose of greater than 5,00 $\mu\text{J}/\text{cm}^2$ in a single pass to achieve kill rate at least 99% (log 2) of virus/bacteria susceptible to this dose.
3. In addition, the UVGI system shall be designed to provide effective destruction and prevention of growth of bacteria, virus, mold, fungi and microbiological species and to provide a minimum intensity of not less than 500 $\mu\text{w}/\text{cm}^2$ on AHU coil and shall envelope the entire surface area of the cooling coil.
4. UV Lamps section inside of air handling units must include modules with a proper number of lamps of different sizes and wattages, all with mounting frames. UV-C lamps are equal spaced and positioned in a grid through which airflow in the ahu is forced to move. UV lamp section should be placed after/before cooling coil section.
5. UV Lamps should be designed to adapt to different sizes and cross sections of AHU, placing one device to cover the surface or matching more devices together side-by-side, one on the other (overlapping), in series, etc. Ballasts specific for Light Progress UV-C lamps. They optimize lamps performance and durability. UV Lamps should be made with high quality and extremely durable components and work perfectly in difficult operating conditions (high humidity, low temperature, etc.).
6. The UV-C should be of 254 nm wavelength and no ozone shall be produced as a by-product.
7. The power source shall be available in 230V AC 50 Hz. and be able to operate reliably in indoor environments ranging from 4°C to 40°C temperature, with relative humidity up to 100%.
8. The lamps should be of High Output type (800 mA each). These lamps should be specially designed to be used in low temperature applications and shall provide a rated average life of 16,000 hours.
9. The UV-C lamp shall be internally coated to reduce solarisation and of such intensity as to provide minimum performance as listed below.
10. The fixtures shall be non-corrosive hardware so that the fixture does not vibrate or loosen. Safety interlock switches are to be installed on all access doors where UV intensity may be present.
11. Length of each lamp used in the germicidal system shall be adequately long to cover the AHU width.
12. The vendor shall supply the test certificate for each unit showing conformance to the technical specifications.
13. The MOC of each lamp should be High Purity Fused Quartz.
14. The ballasts must be integrated onto the module in a sealed enclosure to protect against moisture and humidity present in the AHU or duct.
15. As it is a critical system hence AHU OEM's or any other system supplier's/ Contractor's shall not supply, install and commission the UVGI system to ensure accurate installation the UVGI system shall be supplied, installed and commissioned by either OEM itself or its authorized system integrator only. Only project specific authorization letter shall be acceptable.

MM. AIR & DIRT SEPARATOR & DIRT SEPARATOR

1. Dirt Separator

Dirt separator. Flanged connections, complete with Brass drain valve 1" F (from DN 50 to DN 150), 2" F (from DN 200 to DN 300). Complete with a set of concentric metal mesh surfaces to create the swirling motion required to facilitate the release of dirt to the surfaces.

Epoxy resin coated steel body. Stainless steel internal element. EPDM hydraulic seals. Medium water and non-hazardous glycol solutions excluded from the guidelines of EC directive 67/548; maximum percentage of glycol 50%. Maximum working pressure 10 bar. Working temperature range 0–110°C. Particle separation rating down to 5 µ. For flanged and weld-end models DN 50 (from DN 50 to DN 150). Working temperature range 0–100°C.

Floor brackets for sizes DN 200 (from DN 200 to DN 300).

The third party TNO certification is required for the separation of dirt with given limits

2. Air & Dirt Separator

Deaerator-dirt separator. Flanged connections, complete with Brass drain valve 1" F (from DN 50 to DN 150), 2" F (from DN 200 to DN 300). Complete with a set of concentric metal mesh surfaces to create the swirling motion required to facilitate the release of micro-bubbles and dirt to the surfaces.

Epoxy resin coated steel body. Brass automatic air vent valve body. Stainless steel internal element. PP float. Brass float guide and stem. Stainless steel float lever and spring. EPDM hydraulic seals. Medium water and non-hazardous glycol solutions excluded from the guidelines of EC directive 67/548; maximum percentage of glycol 50%. Maximum working pressure 10 bar. Working temperature range 0–110°C. Particle separation rating down to 5 µ. For flanged and weld-end models DN 50 (from DN 50 to DN 150). Working temperature range 0–100°C.

Floor brackets for sizes DN 200 (from DN 200 to DN 300).

The third party TNO certification is required for the separation of air & dirt with given limits

NN. ROOM PRESSURE GAUGE

Room Pressure Gauge (For ICU, Isolation Rooms, Pre-operative & Post-operative, OT etc):-

Digital Differential Pressure Gauge:

1. Gauge shall be CE/RoHS listed.
2. LCD Display with 3¹/₂ Digit.
3. Country of origin should be United States of America.
4. Die Cast Aluminium enclosure with IP65 protection class.
5. The Gauge should work on standard AA or AAA Batteries.
6. The sensor should be calibrateable and rerangeable by **COML** protocol on site
7. Cutout Size should be 114 mm
8. Accuracy should be Batter then +/- 0.5%
9. The gauge should be able to set minimum 5 units on site.

OO. AIR CURTAIN

For Hospital Block ground floor entrance

Non recirculating centrifugal Air Curtains

Artistically designed curvaceous body constructed in aluminium extruded powder coated sections with powder coated sheet metal base and mounting plates.

Motors constructed in aluminium body to enable rapid cooling, with copper winding, bearing based motors made in CRNO core to run continuously for 24X7 operation, with thermal overload protection.

Dynamically balanced centrifugal Blowers made in virgin plastic, with aerodynamically designed fins to deliver high volume of air., the suction grills should be made in plastic.

Air Curtain should have dual speed with max. Velocity at Nozzle between 19-21 m/s.

Air curtain should be coupled with the door, with a automatic magnetic limit switch, to Synchronise working of air curtain with opening of the door.

Air Curtains should be 2 feet long. Air Flow should be 1000 CFM, Noise level <60 db "A", with 1 Motor and 2 Blowers
Air Curtains should be 3 feet long. Air Flow should be 1500 CFM, Noise level <60 db "A", with 2 Motor and 3 Blowers
Air Curtains should be 1 meter long. Air Flow should be 1500 CFM, Noise level <60 db "A", with 2 Motor and 3 Blowers
Air Curtains should be 4 feet long. Air Flow should be 2000 CFM, Noise level <60 db "A", with 2 Motor and 4 Blowers
Air Curtains should be 5 feet long. Air Flow should be 2500 CFM, Noise level <60 db "A", with 3 Motor and 5 Blowers.
Air Curtains should be 6 feet long. Air Flow should be 3000 CFM, Noise level <60 db "A", with 3 Motor and 6 Blowers
Air Curtains should be 7 feet long. Air Flow should be 3500 CFM, Noise level <60 db "A", with 4 Motor and 7 Blowers

PP. FAN COIL UNIT KIT

Connection and regulation kit for HVAC fan coil units in heating and cooling systems. Complete with: pressure independent control valve, three-way shut-off valves, integrated by-pass, Venturi device with pressure test ports (only for dedicated versions), filtering cartridge and pre-formed shell insulation made of PPE.

Sizes DN 15, DN 20 and DN 25. Main connections on system side 1/2" F (from 1/2" to 1"); terminal unit side 3/4" M (from 3/4" to 1 1/4"). Connections centre distance: 80 mm. Pressure test port connections 1/4" F (ISO 228-1) with cap (only for dedicated versions). Connection for code 145014 and 6565 series thermo-electric actuators. M30 p.1,5.

Flow rate adjustment range of the group with Venturi device: 0,02–0,10 m³/h (code 149..0 H10); 0,10–0,20 m³/h (code 149..0 H20); 0,20–0,40 m³/h (code 149..0 H40); 0,40–0,80 m³/h (code 149..0 H80); 0,80–1,20 m³/h (code 149..0 1H2); 1,20–1,80 m³/h (code 149..0 1H8); 1,80–3,00 m³/h (code 149..0 3H0).

Flow rate adjustment range of the group without Venturi device: 0,02–0,20 m³/h (code 149..0 H20); 0,08–0,40 m³/h (code 149..0 H40); 0,08–0,80 m³/h (code 149..0 H80); 0,12–1,20 m³/h (code 149..0 1H2); 0,18–1,80 m³/h (code 149..0 1H8); 0,3–3,00 m³/h (code 149..0 3H0).

Linear or equipotential flow rate adjustment characteristic, which can be set up by actuator depending on the characteristics of the terminal unit. Maximum working pressure 25 bar. Maximum differential pressure with actuator code 145014 (and 656. series) installed: 5 bar. Nominal operation Δp range 25–400 kPa. Working temperature range -10–120°C. Ambient temperature range 0–50°C. Strainer mesh size 800 μ m. Medium: water and glycol solutions; maximum percentage of glycol 50%. Dezincification resistant alloy body and adjustment headwork; stainless steel strainer mesh; EPDM diaphragm, obturator and seals.

All included valves, actuator (ON & OFF / Modulating type), pressure independent control valve, three-way shut-off valves, integrated by-pass, Venturi device with pressure test ports (only for dedicated versions), filtering cartridge and pre-formed shell insulation made of PPE should of from single manufacturer, **NO locally assembled unit is acceptable.**

Technical specifications

Materials

Body: dezincification resistant alloy

EN 12165 CW602N

Strainer mesh: AISI 304

Shut-off valves knobs: PA6G30

PICV

Headwork: dezincification resistant alloy

EN 12164 CW602N

Control stem and piston: stainless steel

EN 10088-3 (AISI 303)

Obturator seat: -0,02–0,4/0,08–0,8/0,12–1,2 m³/h: PTFE

-0,18–1,8/0,30–3,00 m³/h: stainless steel EN 10088-3 (AISI 303)

Obturator: EPDM

Pressure regulator membrane: EPDM

Springs: stainless steel EN 10270-3 (AISI 302)

Seals: EPDM

Seals: non-asbestos fibre

Pre-adjustment indicator: PA6G30

Knob: PA6

Connections

System side 1/2" F (DN 15) - 3/4" F (DN 20) - 1" F (DN 25)

Terminal unit side: 3/4" M (DN 15) - 1" M (DN 20) - 1 1/4" M (DN 25)

Performance

Medium: water, glycol solutions

Maximum percentage of glycol: 50%

Max. working pressure: 25 bar

Max. differential pressure with actuator

code 145014 and 656. series thermo-electric actuators: 5 bar

Working temperature range: -10–120°C

Ambient temperature range: 0–50°C

Nominal Dp control range: 25–400 kPa

Flow rate regulation range: 0,02–3,00 m³/h

(see hydraulic characteristics)

Max. flow rate, with 656. series thermo-electric actuator fitted,

reduced by: 0,02–0,4/0,08–0,8/0,12–1,2 m³/h: 20%

0,18–1,8/0,30–3,00 m³/h: 25%

Strainer mesh size: 800 µm

Insulation

Material: PPE

Density: 30 Kg/m³

Thermal conductivity: 0,037 W/(m·K) at 10°C

Reaction to fire (UL94): class HBF



FIG: FAN COIL KIT

QQ. TESTING, ADJUSTING AND BALANCING

The AC Contractor shall have a dedicated experienced, specialized, approved, testing and commissioning (T&C) team/ agency responsible for coordination with other trades, preparation of T&C plan method statement & T&C procedures, organizing & scheduling the T&C activities along with the progress of works, supervision any re-testing, coordination with third parties for commissioning & certification, organizing & performing testing for satisfaction of all Statutory Bodies, T&C record documentation & handover. The contractor shall perform testing, adjusting & balancing (TAB) through specialized agency. The details of the agency shall be submitted to the Engineer-In-Charge for approval. TAB shall also include measurement of performance parameters (like temperature, humidity, pressure differential) of HVAC system in different areas/rooms and the full report along with all other TAB testing and balancing data shall be submitted at the time of handing over the system. Testing shall be done in two season i.e. July-August & December-January.

1. General

- a. Testing, adjusting and balancing of heating, ventilating and air-conditioning systems at site.
- b. Testing, adjusting and balancing of HVAC Hydronic system at site.
- c. Testing, adjusting and balancing of exhaust system at site.
Comply with current editions of all applicable practices, codes, methods of standards prepared by technical societies and Assoc. ciations including:
ASHRAE: 2007 HVAC Application or latest version.
Manual for the Balancing and Adjustment of air distribution system.
- d. AC Contractor shall submit a Test, adjust, balance procedure/method statements/charts for approval to AAHII.

2. Performance

- a. Verify design conformity.
- b. Establish fluid flow rates, volumes and operating pressures.
- c. Take electrical power readings for each motor.
- d. Establish operating sound and vibration levels.
- e. Adjust and balance to design parameters.
- f. Record and report results as per the formats specified.

3. Definitions

- a. Test: To determine quantitative performance of equipment.
- b. Adjust : To regulate for specified fluid flow rates and air patterns at terminal equipment (e.g. reduce fan speed, throttling etc.)
- c. Balance : To proportion within distribution system (submains, Branches and terminals) in accordance with design quantities.

4. Testing, Adjusting and Balancing (TAB) Procedures

The following procedures shall be directly followed in TAB of the total system. Before commencement of each one of the TAB procedure explained hereunder, the AC Contractor shall intimate the AAHII about his readiness to conduct the TAB procedures in the format given in these specifications.

5. Description of System and Requirements

Adjust and balance the following system to provide most energy efficient operation compatible with selected operating conditions.

- a. All supply, return and outside air systems.
- b. All exhaust air systems.
- c. All chilled water systems.
- d. All cooling tower (condenser) water systems.
- e. Emergency purge systems.

6. Air Systems

I. Air Handlers Performance

The TAB procedure shall establish the right selection and performance of the AHUs with the following results :

- a. Air-IN DB and WB temperature.
- b. Air-OUT DB and WB temperature.
- c. Dew point air leaving.
- d. Sensible heat flow.
- e. Latent heat flow.
- f. Sensible heat factor.
- g. Fan air volume.
- h. Fan air outlet velocity.
- i. Fan static pressure.
- j. Fan power consumption.
- k. Fan speed.

II. Air distribution

Both supply and return air distribution for each AHU and for areas served by the AHU shall be determined and adjusted as necessary to provide design air quantities. It shall cover balancing of air through main and branch ducts.

III. The Preparatory Work

To conduct the above test, following preparatory works are required to be carried out including the availability of approved for construction shop drawings and submittals:

- a. All outside air intake, return air and exhaust air dampers are in proper position.
- b. All system volume dampers and fire dampers are in full open position.
- c. All access doors are installed & are air tight.
- d. Grilles are installed & dampers are fully open.
- e. Provision and accessibility of usage of TAB instruments for traverse measurements are available.
- f. All windows, doors are in position.
- g. Duct system is of proper construction and is equipped with turning vanes and joints are sealed.
- h. Test holes and plugs for ducting.

7. Hydronic System Balancing

I. The Hydronic system shall involve the checking and balancing of all water pumps, piping network (main & branches), the heat exchange equipment like cooling and heating coils, condensers and chillers and cooling towers in order to provide design water flows.

II. The essential preparation work, must be done by the HVAC Contractor prior to actual testing, adjusting and balancing of HVAC system and ensure following :

- Availability of co-ordinated drawings and approved submittals and system sketch with design water flows specified thereon.
- Hydronic system is free of leaks, is hydrostatically tested and is thoroughly cleaned, flushed and refilled.
- Hydronic system is vented.

III. The AC Contractor shall confirm completion of the basic procedures and prepare check lists for readiness of system balance.

- a. Check pumps operation for proper rotation and motor current drawn etc.
- b. Confirm that provisions for TAB measurements (Temperature, pressure and flow measurements) have been made.
- c. Open all shut-off valves and automatic control valves to provide full flow through coils. Set all balancing valves in the preset position, if these values are known. If not, shut all riser balancing valves except the one intended to be balanced first.

Balancing work for both Chilled Water System and Condenser Water System shall be carried out in a professional manner and test reports in the specified format shall be prepared and presented to the AAHII / Consultant for endorsement.

8. Readiness for Commencement of TAB

Before starting of any of the tests, the readiness to do so should be recorded as per the prescribed check list.

9. TAB Instruments

I. Air Measuring Instruments

- a. For measuring DB and WB temperature, RH and dew point, microprocessor based TSI USA make VelociCalc Plus Meter, Model 8386, or equivalent shall be used. This instrument shall be capable of calculating the sensible, latent total heat flows, sensible heat factor and give printouts at site and have data logging/downloading facility.
- b. For measuring Air velocity, DB temperature and Air volume, TSI USA make VelociCalc meter model 8386/ 8345 or equivalent shall be used. It shall be able to provide instant print out of recorded Air volume readings.
- c. Pitot tube.
- d. Electronic Rotary Vane Anemometer TSI make or equivalent.
- e. Accubalance Flow Measuring Hood TSI make or equivalent.

[All above instruments shall have a valid certification from a reputed testing institution.]

II. Hydronic Measuring Instruments

- a. For measurement of water flow across balancing valves, instruments as provided by the manufacturer of the valves specific to the type of valves shall be need. This shall include but not be limited to differential pressure manometers. Temperature shall be measured using electric thermometers from thermowells provided at strategic location by the HVAC Contractor. The water balancing shall be carried out being computer simulation program provided / certified by the balancing valve manufacturer.

III. Rotation Measuring Instrument

- a. Electronic DigitalTachometer.

IV. Temperature & RH Measuring Instrument

- a. TSI VelociCalc model 8386 / VelociCalc model 8345 or equivalent.

V. Electrical Measuring Devices

- a. Clamp on Volt ammeter.
- b. Continuity Meter.

VI. Vibration and Noise Levels

Vibration and alignment field measurements shall be taken for each circulating water pump, water chilling unit, air handling unit and fan driven by a motor over 10 HP. Readings shall include shaft alignment, equipment vibration, bearing housing vibration, and other test as directed by the PMC.

Sound level readings shall be taken at ten (10) locations in the building as selected by the Contractor/ AAHII. The readings shall be taken on an Octave Band analyzer in a manner acceptable to him. The AC Contractor shall submit test equipment data and reporting forms for review. In order to reduce the ambient noise level the readings shall be taken at night. All test shall be performed in the presence of AAHII/ Consultant or his authorized representative.

SYSTEM TESTING ADJUSTMENT AND BALANCING

i. SCOPE

- a) Testing, adjusting and balancing of heating, ventilating and air-conditioning systems at site.
- b) Testing, adjusting and balancing of HVAC Hydronic system at site.
- c) Testing, adjusting and balancing of exhaust system at site.

Comply with current editions of all applicable practices, codes, methods of standards prepared by technical societies and associations including:

ASHRAE: 1999 HVAC Application

Manual for the Balancing and Adjustment for air distribution System

ii. PERFORMANCE

- a) Verify design conformity.
- b) Establish fluid flow rates, volumes and operating pressures.

- c) Take electrical power readings for each motor.
- d) Establish operating sound and vibration levels.
- e) Adjust and balance to design parameters
- f) Record and report results as per formats specified.

iii. DEFINITIONS

Test: To determine quantitative performance of equipments.

Adjust: To regulate for specified fluid flow rates and air patterns at terminal Equipments (e.g. reduce fan speed, throttling etc.)

Balance: To proportion within distribution system (sub mains, branches and Terminals) in accordance with design quantities.

iv. TESTING, ADJUSTING AND BALANCING (TAB) PROCEDURES

The following procedures shall be directly following in TAB of the total system.

Before commencement of each one of the TAB procedure explained hereunder, the contractor shall intimate the Engineer-In-Charge about his ready to conduct the TAB procedures in the format given in these specifications.

v. DESCRIPTION OF SYSTEM AND REQUIREMENT

Adjust and balance the following system to provide most energy efficient operation compatible with selected operating conditions.

- All supply, return and outside air systems.
- All exhaust air systems
- All chilled water systems.
- All cooling tower (condenser) water systems.
- Emergency purge systems

vi. AIR SYSTEMS

a) Air Handlers Performance

The TAB procedure shall establish the right selection and performance of the AHUs with the following results.

- Inlet air Dry and Wet bulb temperatures.
- Outlet air Dry and Wet bulb temperatures.
- Air leaving dew point temperature
- Sensible heat Pickup
- Latent heat Pickup
- Sensible hat factor

b) Air distribution

Both supply and return air distribution for each AHU and for areas served by the AHU shall be determined and adjusted as necessary to provide design air quantities. It shall cover balancing of air through main and branch ducts utilizing telescoping probes of Electronic Rotating Vane Anemometers and Accubalance for grilles and diffusers.

c) The Preparatory work

To conduct the above test, following preparatory works are required to be carried out including the availability of approved for construction shop drawings and submittals.

All outside air intake return air and exhaust air dampers are in proper position.

All system volume dampers and fire dampers are in full open position.

All access doors are installed & are airtight.

Grilles are installed & dampers are fully open.

Provision and accessibility of usage of TAB instruments for transverse measurements are available.

All windows, doors are in position.

Duct system is of proper construction and is equipped with turning vanes and joints are sealed.

vii. HYDRONIC SYSTEM BALANCING

The Hydronic system shall involve the checking and balancing of all water pumps. Piping network (main & branches), the heat exchange equipments like cooling and heating coils, condensers and chillers and cooling towers in order to provide design water flows.

The essential preparation work, must be done by the HVAC contractor prior to actual testing, adjusting and balancing of HVAC system and ensure following:

- a. Availability of co-ordinate drawings and approved submittals and system sketch with design water flows specified thereon.
 - b. Hydronic system is free of leaks, is hydrostatically tested and is thoroughly cleaned, flushed and refilled.
 - c. Hydronic system is vented.
 - d. The contractor shall confirm completion of the basic procedures and prepare checklists for readiness of system balance.
 - e. Check pumps operation for proper rotation and motor current drawn etc.
 - f. Confirm that provisions for TAB measurements (Temperature, pressure and flow measurements) have been made.
 - g. Open all shut-off valves and automatic control valves to provide full flow through coils. Set all balancing valves in the preset position, if these values are known. If not, shut all riser balancing valves except the one intended to be balanced first.
 - h. Balancing work for both Chilled Water System and Condenser Water System shall be carried out in a professional manner and test reports in the specified format shall be prepared and presented to the AAHII / Engineer-In-Charge for approval.
- viii. READINESS FOR COMMENCEMENT OF TAB
Prior to commencement of any test, the readiness to do so should be recorded as per the prescribed checklist.
- ix. TAB INSTRUMENTS
- i. Air measuring Instruments
For measuring DB and WB temperature, RH and dew point, microprocessor, suitable instrument shall be used. This instrument shall be capable of calculating the sensible, latent total heat flows, sensible heat factor and give printouts at site and have data logging/downloading facility.

For measuring Air velocity, DB temperature and Air volume, suitable instrument shall be used. It shall be able to provide instant print out of recorded Air Volume readings.
Pitot tube.
Electronic Rotary Vane Anemometer.
Accubalance Flow Measuring Hood.
 - ii. Hydronic Measuring Instruments
For measurement of water flow differential pressure and temperature, The instrument shall have a built-in-microcomputer capable of giving readings for pressure differential flow rate and temperature.
 - iii. Rotation Measuring Instrument
Electronic Digital Tachometer
 - iv. Temperature & RH Measuring Instrument
 - v. Electrical Measuring Devices
 - Clamp on Volt ammeter
 - Continuity Meter
 - vi. Vibration and Noise Levels
Vibration and alignment field measurements shall be taken for each circulating water pump, water chilling unit, air handling unit and fan driven by a motor over 10 HP. Readings shall include shaft alignment, equipments vibration, bearing housing vibration, and other test as directed by the Engineer-In-Charge.
Sound level readings shall be taken at ten (10) locations in the building as selected by the Engineer-In-Charge. The readings shall be taken on an Octave Band Analyzer in a manner acceptable to him. The contractor shall submit test equipments data and reporting forms for review. In order to reduce the ambient noise level the readings shall be taken at night.

All tests shall be performed in the presence of AAHII / Engineer-In-Charge.

RR. SYSTEM READY TO BALANCE CHECK LIST (NOT LIMITED TO FOLLOWING)

	Description	Ready		Date Corrected
		Yes	No	
1.	HVAC Units (AHU)			
	a) General			
	Louvers installed			
	Manual dampers open & locked			
	Automatic dampers set properly			
	Housing Construction leakage			
	Access doors-leakage			
	Condensate drain piping and pan			
	Free from dirt and debris Nameplate data			
	b) Filters			
	Type and size			
	Number			
	Clean			
	Frame-Leakage			
	c) Coils (Hydronic)			
	Size and rows			
	Fin spacing and condition			
	Obstructions and / or debris			
	Airflow and direction			
	Piping leakage			
	Correct piping Connections and flow			
	Valves open or set			
	Air vents or steam traps			
	Provision made of TAB Measurements			
	d) Fans			
	Rotation			
	Wheel clearance and balance			
	Bearing and motor lubrication			
	Drive alignment			
	Belt tension			
	Drive set screws tight			
	Belt guard in place			
	Flexible duct connector alignment			
	Starters and disconnect switches			
	Electrical service & connections.			
	Nameplate data			
	e) Vibration Isolation Springs & Compression			
	Base Level & Free			
2.	Duct System			
	a) General			
	Manual dampers open & locked			
	Access doors closed and tight			
	Fire dampers open and accessible			
	Terminal units open and set			
	Registers and diffusers open and set			

Turning vanes in square elbows
Provisions made for TAB measurements.
Systems installed as per plans.
Ductwork sealed as required

- b) Architectural Windows installed and closed.
Doors closed as required.
Ceiling plenums installed and sealed.
Access doors closed and tight
Air shafts and openings as required

3. Pumps

- a) Motors.
Rotation
Lubrication
Alignment
Set screws tight
Guards in place
Tank level and controls.
Starters and disconnect
switches Electrical service &
connections. Nameplate data.
- b) Piping
Correct flow
Correct connections
Leakage
Valves open or set
Strainer clean
Air vented
Flexible connectors
Provisions made for TAB measurements
- c) Bases
Vibration isolation.
Grouting
Leveling

4. Hydronic Equipment

- a) Heat Exchangers/HW coil
Correct flow and connections
Valves open or set
Air vents or steam traps
Leakage
Provisions made for TAB measurements
Nameplate data.

5. Refrigeration Equipment

- Crankcase heaters energized
Operating controls and devices.
Safety controls and devices.
Valves open
Piping connections and flow
Flexible connectors

Oil level and lubrication
Alignment and drives.
Guards in place.
Vibration isolation.
Starters, contactors and disconnect switches.
Electrical connectors.
Nameplate data.

6. Hydronic Piping systems.
Leak tested. Fluid levels and
make-up Relief or safety
valves.
Compression tanks and air vents.
Steam traps and
connections. Strainers
clean valves open or set
Provisions made for TAB measurements.
Systems installed as per plans.
7. Controls System
Data centers.
Outdoor return air reset
Economizer
Static pressure
Room controls.
8. Other Checks.
 - a) Other trades or personnel notified of TAB work requirements.
 - b) Preliminary data complete
 - c) Test report forms prepared.

SS. INSTRUMENT CALIBRATION REPORT

CHILLER TEST REPORT

PROJECT _____ **UNIT** _____

LOCATION _____

MANUF. _____ **MODEL** _____ **SERIAL NO.** _____

CAPACITY _____ **REFRIG** _____ **STARTER** _____ **HEATER SIZE** _____

Description _____ **Design** _____ **Actual** _____

- a) COMPRESSOR
 - Make/ Model Serial No.
 - Type (Reciprocating, Centrifugal, Screw, Scroll) Piping Material Suction Pr / Tem.
 - Discharge Pr/Temp
 - Refrigerant
 - Oil Pump Type
 - Oil Pressure
 - Oil Failure Switch Pressure
 - Unload Arrangement
 - Unload Set Points
 - Drive
 - Compressor Speed
 - Oil Level
 - Oil Temperature
 - L P Setting
 - H P Setting
 - Anti Freeze Setting
 - Purge Unit Type
 - Purge Operation Checked
- b) COMPRESSOR MOTOR
 - Make / Model
 - Type
 - Voltage
 - Motor Rated Current
 - Motor F L Current
- c) MOTOR STARTER
 - Make / Model
 - Type
 - Voltage
 - Amps
 - O/L Release Range
- d) EVAPORATOR
 - Make / Model
 - No. of Passes
 - Ref : Level
 - Ref : Pressure / Temperature
 - Ent. Water Temp/Pressure
 - Leaving Water Temp/Pressure
 - Temperature Difference
 - Pressure Difference
 - Water Quantity
 - Relief Valve Setting
 - IKW / Ton

REMARKS

TEST DATE _____ **READINGS BY** _____

COOLING TOWER TEST REPORT

PROJECT _____ **SYSTEM** _____
LOCATION _____
MANUF. _____ **MODEL** _____ **SERIAL NO.** _____
NOM. CAPACITY _____ **WATER TREAT.** _____
Description _____ **Design** _____ **Actual** _____

- a) TOWER/ MOTOR
 - Make/ Model
 - Type
 - Tons
 - No. of Fan Motors
 - Motor HP / RPM
 - Motor / Drive
 - Motor Speed
 - Motor Rated Current
 - Motor FL Current
 - O/L Release Setting
 - CT Range
 - CT Approach
- b) TOWER / FAN
 - No. of Fans
 - Type/ Drive of Fan
 - Fan Dia
 - Fan Speed
 - Air Inlet Temperature
 - Air Outlet Temperature
 - Fan Air Quantity
 - Water Bleed GPM
- c) TOWER / AIR DATA
 - Fan CFM
 - Outlet S.P.
 - Avg. Ent. W.B.
 - Avg. Lvg. W.B.
 - Ambient W.B.
 - Fan RPM
 - Voltage
 - Amps
- d) TOWER / WATER DATA
 - Ent//Lvg./Water Pressure
 - Ent//Lvg./Water Temperature
 - Water Temperature - T
 - GPM
 - Bleed GPM
 - Voltage
 - Amps

REMARKS

TEST DATE _____ **READINGS BY** _____

PUMP TEST REPORT

PROJECT _____

DATA PUMP NO. PUMP NO. PUMP NO. PUMP NO. PUMP NO.

Location
Service
Manufacturer
Model Number
Serial Number
GPM/Head
Req. NPSH
Pump RPM
Impeller Dia.
Motor Mfr. / Frame
Motor HP/RPM
Volts/Phase/Hertz
F.L Amps
Seal Type
Pump Off-
Press.
Valve Shut Diff.
Act.Impeller Dia.
Valve Open diff.
Valve Open GPM
Final Dischg.
Press.
Final Suction Press.
Final Ap
Final GPM
Voltage
Amperage

REMARKS

TEST DATE _____ **READINGS BY** _____

AIR HANDLING EQUIPMENT TEST REPORT

PROJECT _____

SYSTEM/UNIT _____ **LOCATION** _____

Description **Data**

- a) UNIT
- Make/Model No.
- Type/Size
- Serial Number
- Arr./Class
- Discharge
- Pully dia/Bore
- No. Belts/make/size
- No.Filters/type.size (Pre.)
- No.Filters/type/size (secondary)

- b) MOTOR
- Make / Frame
- H.P / RPM
- Volts/Phase/cycles F.L amps.
- Pully Dia/Bore Pully /Distance.
- Total Cfm
- Total S.P
- Fan RPM
- Motor Volts. T
- Outside air Cfm
- Return air Cfm
- Discharge S.P
- Cooling Coil S.P
- Filters S.P

REMARKS

TEST DATE _____ **READINGS BY** _____

COOLING/ HEATING TEST REPORT (AHU)

PROJECT _____

COIL DATA	COIL NO.	COIL NO.	COIL NO.	COIL NO.
System				
Number				
Location				
Coil Type				
No. Rows				
Fins/In				
Manufacturer				
Model Number				
Face Area, Sq.Ft.				
TEST DATA	DESIGN	DESIGN	DESIGN	DESIGN
	/	/	/	/

	ACTUAL	ACTUAL	ACTUAL	ACTUAL
Air Qty.				
CFM Air				
Vel.FPM				
Press.Dro				
p In.				
Out.Air DB/WB				
Ret. Air DB/WB				
Ent.Air DB/WB				
Lvg.Air DB/WB				
Air AT				
Waer flow. GPM				
Press.Drop.PSI				
Ent.Water				
Temp				
Lvg .Water				
Temp				
Water AT				
Exp.Valve/Refri				
g Refrig.Suction				
Pr.				
Refrig.Suct.Tem				
p				
Inlet Steam				
press.				

REMARKS

TEST DATE _____ **READINGS BY** _____

FAN COIL TEST REPORT

PROJECT _____

DATE _____ **LOCATION** _____

MANUFACTURER _____

AREA SERVED FCU MAKE CAPACITY TR TEMPERATURE DEG. F
GRILLE ROOM

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.

REMARKS

TEST DATE _____ **READINGS BY** _____

FAN TEST REPORT

PROJECT _____

FAN DATA	FAN NO.	FAN NO.	FAN NO.
-----------------	----------------	----------------	----------------

- Location
- Service
- Manufacturer
- Model No.
- Serial No.
- Type / Class
- Motor Make / Style
- Motor H.P/RPM/ Frame
- Volts/Phase/Cycles F.L
- Amps.
- Motor pully Dia./Bore
- Fan pully Dia./Bore
- No. Belts/ Make/Size
- Pully Distance.
- CFM
- FAN RPM
- S.P IN/OUT
- TOTAL S.P
- Voltage
- Amperage

REMARKS

TEST DATE _____ **READINGS BY** _____

RECTANGULAR DUCT TRAVERSE REPORT

PROJECT _____ **SYSTEM** _____

LOCATION/ ZONE _____ **ACTUAL AIR TEMP.** _____ **DUCT S.P** _____

DUCT SIZE _____ **SQ.FT.** _____ **REQUIRED FPM** _____ **CFM** _____ **ACTUAL FPM** _____ **CFM** _____

POSITION 1 2 3 4 5 6 7 8 9 10 11

1

2

3

4

5

6

7

8

9

10

11

12

13

**VELOCITY
SUBTOTALS**

REMARKS

TEST DATE _____ **READINGS BY** _____

GRILLES AND DIFFUSERS TEST REPORT

PROJECT _____ **SYSTEM** _____

OUTLET _____ **MANUFACTURER** _____

TEST APPARATUS _____

S/N	AREA SERVED	OUT LET NO./TYPE/SIZE	DESIGN CFM/VEL	PRLIMINARY VEL/CFM	FINAL VEL/CFM
------------	--------------------	------------------------------	-----------------------	---------------------------	----------------------

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

REMARKS

TEST DATE _____ **READINGS BY** _____

TT. PAINTING WORK

This section deals with painting of various equipment / material supplied under this contract. It gives basic guidance for painting as specified below:-

Application: The original colour of all equipments like water chilling machines, airhandling units etc. which if get damaged during transportation or during installation shall be painted in original shade with the two coat of paint to give a final finish.

All chilled water pipes shall be painted as per standard code of practice and arrows shall be marked to indicate direction of flow of water.

Colour Scheme for The Equipments/ Materials

Description	Standard Colour & Reference	Lettering Colouring
Exposed Duct Work (other than plant room)	As per E-I-C Directions	As per E-I-C Directions
Air Conditioning Duct Work (Plant Rooms)	BSS 111 Pale Blue	Black
Ventilation Duct Duct Work (Plant Rooms)	BSS 111 Pale Blue	Black
Conditioner Casings Air Handling Units, Filter Plenums	BSS 111 Pale Blue	Black
Electrical (Conduit Ducts and Motors)	BSS 557 Light Orange	Black
Chilled Water Pipe	Jade Green	Black
Drains	Black	White
Vents	White	Black
Fans	BSS 111 Pale Blue	Black
Valves and Pipe Line Fittings	White with black handles	Black
Beltguards	Black and yellow diagonal stripes (45 25 mm wide)	
Switchboards- exterior –interior	BS 366 Light Beige	White
Machine Bases, Inertia Bases and Plinths	Charcoal	Grey
Chilling M/C	As Per Manufacturer's Standard	
Pump-sets	Battle ship grey	
Condenser water pipes	Light green	Black
Electrical panels/sub-panel/ remote control console	Light grey powder coated RAL 7032 as per DIN	
Supports for ducts		Silver

UU. IDENTIFICATION OF SERVICES

General

This section comprises of identification of services for each piece of equipment

Valve Labels and Charts

Each valve shall be provided with a label indicating the service being controlled, together with a reference number corresponding with that shown on the Valve Charts and " as fitted" drawings. The labels shall be made from 3 ply (black / white/ black) Traffolyte material showing white letters and figures on a black background. Labels to be tied to each valve with chromium plated linked chain. The labels shall be suitable for minimum 40 characters with font size of 24 minimum. Labelling scheme of each equipment to be submitted for approval from AAHII/ Consultant.

A wall mounted, glass covered plan to the endorsement of the AAHII/ Consultant shall be provided and displayed in each plant room showing the plant layout with pipe work, valve diagram and valve schedule indicating size, service, duty, etc.

All AC equipments shall be provided with permanent mounted identification labels and unique tagging numbers. The shop drawings shall also include these tagging numbers for easy identification on site. It should be co-ordinated with BMS also to ensure consistent equipment tagging among drawings, BMS display and site installation.

Identification of Services

Pipe work and duct work shall be identified by colour bands 150 mm. wide or colour triangles of at least 150 mm. / side. The bands of triangles shall be applied at termination points, junctions, entries and exits of plant rooms, walls, in ceiling spaces, ducts and control points to readily identify the service, but spacing shall not exceed 4.0 metres.

Pipe Work Services

For pipe work services and its insulation the colours of the bands shall comply with BS.1710: 1971. Basic colours for pipe line identification:

Pipe Line Contents	BS. 4800 Colour Reference	Colour
Water	12 D 45	Green
Steam	10 A 03	Grey
Oils	06 C 39	Brown
Gas	08 C 35	Yellow / Brown
Pipe Line Contents	BS. 4800 Colour Reference	Colour
Air	20 E 51	Blue
Drainage	00 E 53	Black
Electrical	06 E 51	Orange

Colour code indicator bands shall be applied as colour bands over the basic identification colour in the various combinations as listed below :-

Pipe Line Contents	Colour Bands to BS. 4800
Water Services :	
Cooling	00 E 55
Fresh / drinking	18 E 53
Boiler feed	04 D 45/00 E 55 / 04 D 45
Condensate	04 D 45/14 E 53 / 04 D 45
Chilled	00 D 55/14 E 53 / 00 D 45
Pipe Line Contents	Colour Bands to BS. 4800
Central Heating Services :	
Below 100 Deg. C	18 E 55/04 D 45/18 E 53

Above 100 Deg. C	04 D 45/18 E 53 /04 D 45
Cold Water Storage	
Tanks:	00 E 55/18 E 53/00 E 55
Hot Water Supply	00 E 55/04 D 45/00 E 55
Hydraulic Power	04 C 33
Sea / River Untreated	Basic Colour only
Fire Extinguishing	04 E 53
Steam Services :	Basic Colour only
Air : Compressed	Basic Colour only
Vacuum	White
Town Gas : Manufactured	14 E 53
Natural	10 E 53
Oils :	
Diesel	00 E 55
Lubricating	14 E 53
Hydraulic Power	04 C 53
Transformer	04 D 45
Drainage and other fluids :	Basic Colour only
Electrical Services :	Basic Colour only

In addition to the colour bands specified above all pipe work shall be legibly marked with black or white letters to indicate the type of service and the direction of flow, identified as follows:-

High Temperature Hot Water	HTHW
Medium Temperature Hot Water	MTHW
Low Temperature Hot Water	LTHW
Chilled Water	CHW
Condenser Water	CONDW
Steam	ST
Condensate	CN

Pipe shall have the letters F and R added to indicate flow and return respectively as well as directional arrows. **Duct Work Services :**

For Duct work services and its insulation the colours of the triangles shall comply with BS.1710 : 1971. The size of the symbol will depend on the size of the duct and the viewing distance but the minimum size should not be less than 150 mm. length per side. One apex of the triangle shall point in the direction of airflow.

Services	Colour	BS.4800 Colour Reference
Conditioned Air	Red and Blue	04 E 53 / 18 E 53
Ward Air	Yellow	10 E 53
Outdoor air	Green	14 E 53
Exhaust / Extract / Recirculated Air	Grey	AA 0 09
Foul Air	Brown	06 C 39
Dual Duct System Hot Supply Air	Red	04 E 53
Cold Supply Air	Blue	18 E 53

In addition to the colour triangles specified above all duct work shall be legibly marked with black or white letters to indicate the type of service, identified as follows:-

Supply Air	S
Return Air	R
Outdoor Air	O
Exhaust Air	E
Smoke Extract Duct	M
Spill Air	A

The colour banding and triangles shall be manufactured from self-adhesive cellulose tape, laminated with a layer of transparent ethyl cellulose tape.

VV. LIST OF ABBREVIATIONS

Followings List of Abbreviations shall have been used in preparing the Tender Specifications, Bill of Quantities & Drawings.

AABC	:	AMERICAN AIR BALANCING COUNCIL
ACH	:	AIR CHANGE PER HOUR
AC	:	AIR CONDITIONING
ACMV	:	AIR CONDUCTING AND MECHANICAL VENTILATION
AHU	:	AIR HANDLING UNIT
ANSI	:	AMERICAN NATIONAL STANDARD INSTITUTE
ARI	:	AMERICAN REFRIGERATION INSTITUTE
ASHRAE:		AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIRCONDITIONING ENGINEER
ASME	:	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTA	:	ASSOC.CIATION OF SHORT - CIRCUIT TESTING AUTHORITIES
ASTM	:	AMERICAN SOCIETY OF TESTING AND MATERIALS
ATG	:	AIR TRANSFER GRILLE
AWS	:	AMERICAN WELDING SOCIETY
BAS	:	BUILDING AUTOMATION SYSTEM
BIS	:	BUREAU OF INDIAN STANDARD
BMS	:	BUILDING MANAGEMENT SYSTEM
BTU	:	BRITISH THERMAL UNIT
CDW	:	CONDENSER WATER
CFM	:	CUBIC FEET PER MINUTE
CHW	:	CHILLED WATER
CMS	:	CENTRAL MONITORING SYSTEM
CRCA	:	COLD ROLLED COLD ANNEALED
CSA	:	CANADIAN STANDARD ASSOC.CIATION
CT	:	COOLING TOWER
CTI	:	COOLING TOWER INSTITUTE
DB	:	DISTRIBUTION BOARD
DDC	:	DIRECT DIGITAL CONTROLLER
DOL	:	DIRECT ON LINE
DFA	:	DELHI FIRE AUTHORITY
DIA	:	DIAMETER
DIDW	:	DOUBLE INLET DOUBLE WIDTH
DX	:	DIRECT EXPANSION
EA	:	EXHAUST AIR
EEPROM :		ELECTRICAL ERASABLE PROGRAM
ELCB	:	EARTH LEKAGE CIRCUIT BREAKER
ETL	:	ELETRICAL TESTING LABORATORIES
EPA	:	ENVIRONMENTAL PROTECTION ACT
FCU	:	FAN COIL UNIT
F/A	:	FLOOR ABOVE
F/B	:	FLOOR BLOW
FCC	:	FIRE COMMAND CENTRE
FD	:	FIRE DAMPER
FFL	:	FINISHED FLOOR LEVEL
FPM	:	FEET PER MINUTE
FPS	:	FOOT PER SECOND
FRP	:	FIBERGLASS REINFORCED PLASTIC
GI	:	GALVANISED IRON
GPM	:	GALLON PER MINUTE
GSS	:	GALVANIZED STEEL SHEET
H/L	:	HIGH LEVEL
HDG	:	HOT DIP GALVANIZED
HDPE	:	HIGH DENSITY POLY ETHANE
HFC	:	HYDRO FLURO CARBON
HP	:	HORSE POWER
HVAC	:	HEATING, VENTILATION & AIR CONDITIONING
IAQ	:	INDOOR AIR QUALITY
IEC	:	INTERNATIONAL ELECTROCHEMICAL COMMISSION
IKW	:	INDICATED KILO WATT
IPD	:	INITIAL PRESSURE DROP

ISO	:	INTERNATIONAL STANDARD ORGANIZATION
KW	:	KILO WATT
L	:	LITRE
LCD	:	LIQUID CRYSTAL DISPLAY
L/L	:	LOW LEVEL
L/S	:	LITRE PER SECOND
LSZH	:	LOW SMOKE ZERO HALOGEN
LT	:	LOW TENSION
L	:	METER
MAX.	:	MAXIMUM
MCB	:	MINIATURE CIRCUIT BREAKER
MCC	:	MOTOR CONTROL CENTRE
MFD	:	MOTORIZED FIRE DAMPER
MIN	:	MINIMUM
MM	:	MILLIMETER
NBC	:	NATIONAL BUILDING CODE
NC	:	NOISE CRITERIA
NEC	:	NATIONAL ELECTRIC CODE
NFPA	:	NATIONAL FIRE PROTECTION ASSOC. CIATION
NPLV	:	NET PART LOAD VALUE
NIST	:	NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY
NEMA	:	NATIONAL ELECTRICAL MANUFACTURERS ASSOC. CIATION
NPSH	:	NET POSITIVE SUCTION HEAD
NTS	:	NOT TO SCALE
OA	:	OUTDOOR AIR
PHE	:	PUBLIC HEALTH ENGINEERING
PLC	:	PROGRAMMABLE LOGIC CONTROLLER
P.C.	:	PERSONAL COMPUTER
PSIG	:	POUNDS PER SQUARE INCH GAUGE
PUF	:	POLYURETHANE FOAM
RA	:	RETURN AIR
RAD	:	RETURN AIR DUCT
RCC	:	REINFORCED CEMENT CONCRETE
RH	:	RELATIVE HUMIDITY
RPM	:	REVOLUTIONS PER MINUTE
SA	:	SUPPLY AIR
SAD	:	SUPPLY AIR DUCT
STD	:	STANDARD
T/A	:	TO ABOVE
TAB	:	TESTING, ADJUSTING AND BALANCING
T/B	:	TO BELOW
TCC	:	TERMINAL CONTROL CENTRE
TFA	:	TREATED FRESH AIR
TOA	:	TREATED OUTDOOR AIR
TP	:	THREE PHASE
TR	:	TONS OF REFRIGERATION
TVOC	:	TOTAL VOLATILE ORGANIC COMPOUNDS
VAV	:	VARIABLE AIR VOLUME
VFD	:	VARIABLE FREQUENCY DRIVES
VIP	:	VIBRATION ISOLATING PAD
VSPS	:	VARIABLE SPEED PUMPING SYSTEM
XLPE	:	CROSS -LINKED POLYETHYLENE
SISW	:	SINGLE INLET SINGLE WIDTH
UL	:	UNDERWRITERS LABORATORIES INC.
WG	:	WATER GAUGE

WW. NOISE & VIBRATION CONTROL

Scope of Work

This section deals with design, supply, installation, testing and commissioning of noise and vibration control equipment and accessories.

Standards

The testing of all noise control equipment and the methods used in measuring the noise rating of air conditioning plant and equipment shall be in accordance with the relevant sections of the following British Standards, unless otherwise stated:

BS 4718: 1971	Methods of Test of Silencers for Air Distribution Systems
BS 2750:	Laboratory and Field Measurement of Airborne Sound
Parts 1-9:1980	Insulation of Various Building Elements
	Recommendations for Field Laboratory Measurement of Airborne and Impact Sound Transmission in Buildings
BS 3638: 1987	Methods of Measurement of Sound Adsorption in a Reverberation Room
BS 4773:	Acoustic Testing.
Part 2: 1976	
BS 4856:	Acoustic performance without additional ducting of forced fan convection equipment.
Part 2: 1976	
Part 5: 1976	Acoustic performance with additional ducting of forced fan convection equipment
BS 4857:	Acoustic Testing and Rating of High Pressure Terminal Reheat Units.
Par 2:1978 (1983)	
BS 4954:	Acoustic Testing and Rating of Induction Units.
Par 2:1978 (1987)	
BS 5643:	1984 Glossary of Refrigeration, Heating, Ventilating and Air Conditioning Terms

General

The air conditioning contractor must take all necessary precautions to have minimum noise generation and its transmission generated by moving plant and equipment to achieve acceptable limits for occupied areas. In addition to the noise level criteria particular attention must be given to the following details at time of ordering plant and equipment and their installation :-

All moving plant / equipment shall be statically and dynamically balanced at manufacturers works and certificates issued.

The isolation of moving plant, machinery and apparatus including lines equipment from the building structure.

Where duct work and pipe work services pass through walls, floors and ceilings, or wherever supported shall be surrounded with a resilient acoustic absorbing material to prevent contact with the structure and minimize the outbreak of noise from plant rooms.

The reduction of noise breakout from plant rooms and the selection of externally mounted equipment and plant to meet ambient noise level requirements of the Specifications.

Electrical conduits and connections to all moving plant and equipment shall be carried out in flexible conduit and cables to prevent the transmission of vibration to the structure and nullify the provisions of anti-vibration mountings.

All duct connections to fans shall incorporate flexible connections, except in cases where these are fitted integral within air handling units.

All resilient acoustic absorbing materials shall be non flammable, vermin and rot proof and shall not tend to break up or compress sufficiently to transmit vibration or noise from the equipment to the structure.

Where practicable, attenuators shall be built into walls and floors to prevent the flanking of noise the duct work systems and their penetrations sealed in the manner previously described.

Where this is not feasible, the exposed surface of the duct work between the attenuators and the wall subjected to noise infiltration shall be acoustically clad as specified.

Ambient noise from cooling tower also shall be assessed to determine the suitable attenuators that can reduce the noise so as not affecting the adjoining public area.

Sound Attenuators

Attenuators shall be provided in ducts in accordance with acceptable noise level criteria. Attenuators shall be constructed from high quality pre-galvanised steel sheet casings with lock formed joints along the casing length. Angle iron cross jointing flanges shall be fitted to silencer casings, drilled as required and finished with red oxide primer paint. Acoustic splitters shall be formed by channel section pre-galvanised sheet steel framework retaining acoustic fill of a density to attain the required performance. Splitters shall have round Nos., ends to give smooth entry and exit conditions to minimise air pressure drops. The acoustic fill shall be protected from the air flow by 22 swg minimum perforated galvanized sheet steel. All attenuators shall be selected against a maximum allowable air pressure drop of 100 Pa. It will be the responsibility of the AC Contractor at the time of placing orders for fan equipment to obtain from the manufacturers, certified sound power levels to enable the selected duct silencers to be checked against the original design information, prior to orders being placed.

Anti-vibration Mountings.

All items of rotating and reciprocating plant and equipment shall be isolated from the structure by the use of anti-vibration pads or mounts with provision of machine levelling arrangement made up of (mixedcellular polyurethane), air handling units fixed on a frame shall be isolated by anti-vibration mountings made up of (mixedcellular polyurethane), shall incorporate machine levelling arrangement and eliminating need of grouting. Fan discharge air connections shall be fitted with approved flexible connections. Axial flow fans shall be mounted on steel legs as diaphragm plates supported on anti-vibration mounts made up of (mixedcellular polyurethane) or suspended using spring loaded hangers to suite the application. Centrifugal pumps shall be mounted on inertia bases consisting of reinforced concrete sub-base, anti-vibration mountings made up of (mixedcellular polyurethane) and concrete filled steel upper plinth. The AC Contractor shall be responsible for providing the steel upper plinth and mountings. Pipe work connections to circulating pumps, chillers, cooler coils and other heat exchanger equipment shall be made with flexible connections as per piping Specifications. The construction of the anti-vibration mountings shall generally comply with the following: - anti-vibration mountings made up of (mixedcellular polyurethane), shall incorporate machine levelling arrangement and eliminate need of grouting, as the principle isolation elements, The manufacturers shall provide anti-vibration mountings made up of (mixedcellular polyurethane), shall incorporate machine levelling arrangement and eliminate need of grouting on chillers/Cooling Towers/Pumps/Air handling units/ TFA/Airwasher/Scrubber/Fans etc. subject to approval.

Inertia Bases for Pumps

The inertia base shall be an all welded mild steel channel frame the minimum depth of which shall be 1/12 of the longest span between isolator but not less than 150 mm. filled with concrete the density of which shall be 2300 kg/m³.

The inertia base shall be sufficiently large to provide support for all parts of the equipment, including any component, which overhands the equipment base, such as suction, and discharge elbows on centrifugal pumps.

The frame shall include pre-located equipment anchor bolts fixed into position and housed in a steel sleeve allowing minor bolt location adjustment.

Isolator support brackets shall be welded into the corners of the base and suitably reinforced for the load of the equipment and base.

Additional reinforcing roads shall be provided at 200 mm. centres to ensure the concrete and frame is adequately stiffened against distortion.

Reference Design Standard

Following standard & guidelines shall be adopted while designing the HVAC System.

- i) National Building Code of India (NBC 20016) with latest revision.

- ii) Energy Conservation Building Code (ECBC 2007) or latest
- iii) ASHRAE latest Hand Books.
 - a) Fundamentals
 - b) HVAC Systems and Equipment
 - c) HVAC Applications
 - d) Refrigeration
 - e) HVAC Design Guidelines for Health Care Facilities ASHRAE Standard 170.
- iv) Duct construction standards as per relevant latest BIS codes standards.
- v) Air filters as per ASHRAE 52.1-1992 or latest and 52.2-2007 or latest
- vi) Indoor Air quality as per ASHRAE 62.1-2010 or latest
- vii) Motors, Cabling, Wiring and accessories as per latest BIS codes.
- viii) National Electric Codes (NEC) latest version ix) ANSI / ASHRAE / IESNA standard 90.1-2009 or latest: Energy standard for building except low rise residential buildings.
- x) ASHRAE standard 55: Thermal Comfort.

BIS Code & Guidelines

Following are the few list of Bureau of Indian Standards Codes for guidelines.

IS : 277 - 1992	Galvanized steel sheet (Plain & Corrugated) wire for fencing.
IS : 554 - 1985 (Reaffirmed 1996)	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 655 - 1963 (Reaffirmed 1991)	Metal air ducts.
IS : 659 - 1964 (Reaffirmed 1991)	Air conditioning (Safety Code)
IS : 660 - 1963 (Reaffirmed 1991)	Mechanical Refrigeration (Safety Code)
IS : 694 - 1990 (Reaffirmed 1994)	PVC insulated (HD) electric Cables for working voltage upto and including 1100 volts.
IS : 732 - 1989	Code of practice for electrical wiring.
IS : 780 - 1984	Sluice valves for water works purposes.
IS : 822-1970 (Reaffirmed 1991)	Code of procedure for inspection of welds.
IS : 1239 (Part - I) - 1990	Mild steel tube
IS : 1239 (Part - II) - 1992	Mild steel Tubulars and other wrought steel pipe fittings.
IS : 1255 - 1983	Code of Practice for installation and maintenance of Power Cables upto and including 33 KV rating (Second Revision)
IS : 1554 - 1988 (Part - I)	PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.
IS : 1897 - 1983 (Reaffirmed 1991)	Copper bus bar / strip for electrical purposes
IS : 2379 - 1990	Colour code for the identification of Pipelines.
IS : 2551 - 1982	Danger notice plate

IS : 3043 - 1987	Code of practice for earthing.
IS : 3103 - 1975 (Reaffirmed 1999)	Code of practice for Industrial Ventilation.
IS : 3837 - 1976 (Reaffirmed 1990)	Accessories for rigid steel conduit for electrical wiring.
IS : 4736 - 1986	Hot-dip zinc coatings on steel tubes.

(Reaffirmed 1998)	
IS : 4894 - 1987	Centrifugal Fan.
IS : 5133 - 1969 (Part-I)	Boxes for the enclosure of electrical (Reaffirmed 1990) accessories.
IS : 5216 - 1982	Guide for safety procedure and practices (Part-I) (Reaffirmed 1990) in electrical work.
IS : 5312 (Part-I) - 1984	Swing - check type reflux non (Reaffirmed 1990) return valves for water works
IS : 5424 - 1989 (Reaffirmed 1994)	Rubber mats for electrical purposes.
IS : 5578 & 11353-1985	Marking and identification of conductors
IS : 6392 - 1971 (Reaffirmed 1988)	Steel pipe flanges.
IS : 8623 - 1993	Low voltage switchgear and control gear assemblies (Requirement for type / partly type tested assemblies)
IS : 8623 - 1993	Bus Bar trunking system (Part - II)
IS : 8828 - 1996	Circuit Breakers for over current protection for house hold and similar installation.
IS : 9537 - 1981 (Part II)	Rigid Steel Conduits for electrical wiring
IS : 10810 - 1988	Methods of test for cables.
IS : 13947-1993 (Part-I)	General rules for low voltage switch gears and control gears.
IS : 13947-1993 (Part-II)	Circuit Breakers IEC 947 - 2
IS : 13947 - 1993 (Part-III)	Switches, disconnectors and fuse for low voltage switch gear and control gear.
IS : 13947 - 1993 (Part-IV)	Low voltage switch gear and control gear for contactors and motor starters
IS : 13947 - 1993 (Part-V)	Control Circuit Devices.
BS : EN:779 - 1993	Filters
IEC	Relevant Sections.
ASTM A-536	Ductile Iron Castings

SAFETY CODES

1. SCOPE
The scope of this sub-section is the minimum safety requirements to be observed during manufacture and erection of the HVAC system as specified herein in addition to the safety norms generally followed:-
2. I.S. STANDARDS
The safety code for mechanical refrigeration IS: 660 and safety code for air conditioning IS: 659 shall be observed.
3. SAFETY REQUIREMENTS
Some of the important safety requirements are as under but not limited to the same:-
 - a. There shall be maintained in a readily accessible place, first aid appliances including adequate supply of sterilized dressings and cotton wool.
 - b. The injured person shall be taken to a public hospital without loss of time.
 - c. Suitable and strong scaffolds shall be provided for workmen for all works that cannot be safely done from ground.
 - d. No portable single ladder shall be over 8 meters in length. The width between side rails shall not be less than 30 cm (clear) and the distance between two adjacent rings shall not be more than 30 cms, when a ladder is used, an extra mazdoor shall be engaged for holding the ladder.
 - e. The excavated material shall not be placed within 1.5 meters of the edge of the trench or half of the depth of trenches whichever is more. All trenches and excavations shall be provided with necessary fencing and lighting.
 - f. Every opening in the floor of a building or in a working platform to be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be one meter.
 - g. No. Floor, roof or other part of the structure shall be so overloaded with debris or material as to render it unsafe.
 - h. Workers employed on mixing and handling materials such as asphalt, cement mortar or concrete & lime mortar shall be provided with protective footwear and rubber hand gloves.
 - i. Those engaged in welding works shall be provided with protective eye shields and glove.
 - j. No paint containing lead or lead products to be used except in the form of paste or readymade paint.
 - k. Suitable facemasks shall be supplied for use of workers when the paint is applied in the form of spray or surface having lead paint dry rubbed and scraped.
 - l. Overalls shall be supplied by the Contractor to the painter and adequate facilities shall be provided to enable the working painter to wash during cessation of the work.
 - m. The ropes used in hoisting or lowering material or as a means of suspension, shall be of adequate quality and adequate strength and free from defects.
 - n. All site personnel shall wear safety helmets whenever they are in the construction/ erection areas.

XX. TECHNICAL SCHEDULE OF EQUIPMENT

(As per relevant IS code wherever applicable)

The capacity/ratings of various equipments in this contract are for guidance purpose only. The contractor shall check in details the design/selection of equipments. EPC contractor shall be finally responsible for maintaining the desired inside conditions and shall not deprive him of the responsibility if selection of equipments is not thoroughly checked. in case of shortfall the a/c contractor shall replace/ modify equipments for achieving desired parameters without any extra cost to AAHII.

1.0	WATER PIPES		
	i. Material	MS	
	ii. Class	'C'	
	iii. Wall Thickness		
	25 MM TO 40 MM	4	
	50 MM TO 65 MM	4.5	
	75 MM	4.8	
	100 MM TO 150 MM	5.4	
	200 MM TO 610 MM	6.35	
2.0	GSS DUCTING		
	i. Class of Galvanizing	VIII (120 GM/SQM)	
	ii. Code of Fabrication	IS - 655 (LATEST)	
	iii. Material of Hangers	MS	
	iv. Quality of Sheet	LFQ	
3.0	INSULATION		
	A) DUCTS		
	i. Material	Fibre Glass wool	
	ii. Density	32 Kg/m3	
	B) ACCOUSTIC LINING		
	i. Material	Fiberglass	
	ii. Density	32 KG/CU.M (minimum)	
	C) PIPE INSULATION		
	i. Material	TF' Quality Expanded Polystyrene	
	ii. Density	18 KG/CU.M (minimum)	

YY. TEST READINGS

CHILLER TEST REPORT

PROJECT _____
 UNIT _____
 LOCATION _____
 MANUFACTURER _____
 MODEL _____ SERIAL NO. _____
 CAPACITY _____ REFRIGERANT _____
 STARTER _____ HEATER SIZE _____

COMPRESSOR	DESIGN	ACTUAL	MOTOR STARTER	DESIGN	ACTUAL
Make/Model			Make/Model		
Serial No.			Type		
Type(Reciprocating /Centrifugal/ Screw / Scroll)					
Piping Material			Amps		
Suction Pr/Tem			O/L Release Range		
Discharge Pr/Temp					
Refrigerant			EVAPORATOR	DESIGN	ACTUAL
Oil Pump Type			Make/Model		
Oil Pressure			No. of Passes		
Oil Failure Sw Pressure			Ref. Level		
Unload Arrangement			Ref: Pressure/ Temperature		
Unload Set Points			Ent. Water Temp/ Pressure		
Drive			Leaving Water Temp/ Pressure		
Compressor Speed			Temperature Difference		
Oil Level			Pressure Difference		
Oil Temperature			Water Quantity GPM		
L P Setting			Relief Valve Setting		
H P Setting			IKW / Ton		
Anti Freeze Setting					
Purge Unit Type					
Purge Operation Checked					
Make/Model			Make/Model		
Type			No. of Passes		
Voltage			Ref: Pressure/ Temperature		

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Motor Rated Current			Ent. Water Temp/Pressure		
COMPRESSOR MOTOR	DESIGN	ACTUAL	CONDENSER	DESIGN	ACTUAL
			No. of Fans		
Motor FL Current			Fan Material		
			Fan Diameter		
REMARKS					
TEST DATE _____					
READING BY _____					
Note : Please Furnish test report for all chillers separately.					

PUMP TEST REPORT

PROJECT				
DATA	PUMP NO	PUMP NO	PUMP NO	PUMP NO
Location				
Service				
Manufacturer				
Model Number				
Serial Number				
GPM/Head				
Req. NPSH				
Pump RPM				
Impeller Mfr./Frame				
Motor Mfr./Frame				
Motor HP/RPM				
Volts/Phase/Hertz				
F.L Amps				
Seal Type				
Pump Off-Press				
Valve Shut Diff				
Actual Impeller Dia				
Valve Open differential				
Valve Open GPM				
Final Dischg.Pressure				
Final Suction Pressure				
Final \square p				
Final GPM				
Voltage				
Amperage				

REMARKS

TEST DATE _____ READINGS BY _____

Note : Please Furnish test report for all CHW pumps.

AIR HANDLING EQUIPMENTS TEST REPORT

PROJECT _____		SYSTEM / UNIT _____			
LOCATION _____					
UNIT	DATA	MOTOR	DATA	DATA	DATA
Make/Motor No.		Make / Frame			
Type/Size		H.P / RPM			
Serial Number		Volts/Phase/Cycles			
Arr./Class		F.Lamps.			
Discharge		Pulley Dia/Bore			
Pulley dia/ Bore		Pulley/ Distance			
No. Belts/make/Size					
No.Filters/type.Size (Pre.)					
No.Filters/type.Size (secondary)					
TEST DATA	DESIGN	ACTUAL	TEST DATA	DESIGN	ACTUAL
Total Cfm			Discharge S.P		
Total S.P					
Fan RPM			Cooling Coil S.P		
Motor Volts			Filters S.P		
Out air Cfm					
Return air Cfm					
REMARKS.					
TEST DATE _____					

READINGS BY _____

Note : Please Furnish above report for all AHU.

RECTANGULAR DUCT TRAVERSE REPORT

PROJECT _____ SYSTEM _____

LOCATION / ZONE _____ **ACTUAL AIR TEMP.** _____ **DUCT**
S.P. _____

DUCT SIZE _____ SQ.FT. _____	REQUIRED FPM _____ CFM _____	ACTUAL FPM _____ CFM _____
--	--	--------------------------------------

1						
2						
3						
4						
5						
6						
7						
VELOCITY SUBTOTALS						

GRILLES AND DIFFUSERS TEST REPORT

PROJECT _____

SYSTEM _____

OUTLET MANUFACTURER _____

TEST APPARATUS _____

REA		OUT LET			DESIGN		INITIAL		FINAL	
SERVED	NO	TYP	SIZE	VEL	CFM	VEL	CFM	VEL	CFM	VEL

REMARKS.

TEST DATE _____ **READINGS**

BY _____

Note : Please Furnish above report for all grilles/diffusers with S.No. marked on respective drawings

ZZ. LIST OF BUREAU OF INDIAN STANDARD CODES

IS 1239 (Part- I) 1979	Mild Steel Tube
IS 1239 (Part - I) 1982	Mild Steel Tubular and Other Wrought Steel Pipe Fittings
IS 4736 - 1986 (Reaffirmed)	Hot Dip Zinc Coatings of Steel Tubes
IS 823-1964	Code of Procedure For Manual Metal Arc Welding of Mild Steel
IS 780-1984	Service Valves For Water Works Purpose
IS 778-1980	Copper Alloy Gate, Globe and Check Valves For Water Works Purpose
IS 1536-1976	Flanges Configuration
IS 5312 (Part -I) 1984	Swing Check Type Reflux Non Return Valves For Water Works
IS 2379-1963	Color Code For Identification of Pipelines
IS 554-1975	Dimension For Pipe Thread Where Pressure Tight Joints Are Required On Threads
IS 655-1963 (Reaffirmed 1991)	Metal Air Ducts
IS 277-1992	Galvanized Steel Sheet For Fencing
IS 4064 Part II-1978	Specific Requirements For Direct Switches of Individual Motors
IS 3854-1969	Switches For Domestic & Similar Purpose
IS 732 (Part III-1902)	Inspection and Testing of Installation
IS 659 - 1964 (Reaffirmed 1991)	Air Conditioning Safety Code
IS 660 - 1963 (Reaffirmed 1991)	Mechanical Refrigeration (Safety Code)
IS 4894 - 1991	Test Code For Centrifugal Fan
IS 3103 -1975 Reaffirmed 1994	Code of Practice For Industrial Ventilation
IS 7240 - 1981	Application & Finishing of Thermal Insulation Material
IS 325	Specifications For Three Phase Induction Motor
IS 3142 - 1993	V Grooved Pulley
BS-EN-779 - 1993	Particulate Air Filters For General Ventilation
IS 702 - 1988	Industrial Bitumen
IS 8183 - 1993	Bonded Mineral Wool
IS 2494 - 1993	V Belts For Industrial Purposes
IS 2062 - 1992	General Purpose Steel
ASHRAE Hand Books	American society of heating, refrigeration and air conditioning books - Applications 1999 - Fundamentals 1997 - System and equipments 1996 - Indoor air quality 62 - 1999

AAA. SPECIFICATIONS FOR PLANT OPTIMIZER

A. SYSTEM DESCRIPTION & FEATURES

A.1. CHILLERS

- Proposed 5 no's chillers having its own inbuilt Microprocessor board controlling internal chiller operations and providing operational & diagnostic data on Modbus RTU / Bacnet IP.
- Communication boards of all the chillers networked together to communicate with CPO PC for monitoring and control.
- The controls for the complete chilled water system will be controlled and monitored via Chiller Plant Optimizer (CPO).

A.2. CPO OWS (OPERATOR WORKSTATION)

- The CPO workstation will serve as a GUI providing graphical screens for individual system like main screen, chilled water system, condenser water system, pumps and cooling tower etc. The access to the CPO system shall be distributed to the different operators with the different level password.
- The individual chillers, pumps and cooling towers will be having individual graphical screen and each screen will contain a button to scroll front and back & to go back to the main screen.
- The status of equipment's shall be indicated with the different colours and the alarms shall pop up on the screen for operator acknowledgement. A separate user log will store the acknowledged and unacknowledged alarms w.r.t. the user.
- The trending of parameters can be done for the selected parameters.
- The scheduling for the equipment's can be done by using the calendar options and all the parameters will be displayed w.r.t the engineering units.

A.3. CHILLED WATER SYSTEM LAYOUT

- The Chilled water piping layout consists of the following:
 1. 5 Nos. water cooled chillers
 2. 6 Nos. Primary Variable Pumps
 3. 6 Nos. Condenser Pumps
 4. 5 Cooling Towers with VFD (each with 2 Fan)
- CPO decides how many units, which specific unit and when it should RUN based upon the control logic fed to it.
- Two no's immersion type temperature sensors are installed in the chilled water supply and return header (one at each header).
- Two no's immersion type temperature sensors are installed in the condenser water supply and return header (one at each header).
- One no. Ambient Temperature cum RH sensor will be installed at suitable location to monitor the outside temperature and RH.
- Two no's DP Sensor will be installed
 1. One at supply and return header to monitor the DP
 2. One at secondary pumps to speed up and slow down the pumps in response system demand.
- 5 nos. of Level switches are installed to monitor the level of water in cooling tower.

B. SEQUENCE OF OPERATION

B.1. CPO OPERATING MODES

There are two modes to operate the CPO:

1. Manual Mode

- Operator can interrupt the chiller sequencing and the sequencing will be made as per the operator decision.

- Operator can decide which chiller with which pump should run by issuing a command from the CPO PC

2. Automatic Mode

- Software Logic will decide the chiller sequencing
- Chillers and its ancillary equipment's will be operated automatically once the CPO enable command is issued.

B.2. EQUIPMENT START SEQUENCE

Once the system is put into "**AUTO**" mode and is enabled the starting of the plant equipment's occurs in the following sequence:

- Based on the equal runtime, CPO first decides the first equipment to START from each group. of Cooling Towers, Condenser Water Pumps, Chilled Water Pumps and the Chillers.
- The Motorized Butterfly Valves of the Chiller's and Cooling Tower's in sequence will open immediately and individual open status of all the valves is taken as feedback to the CPO System.
- Once the opening of all the Motorized Butterfly Valves is confirmed, the Condenser Pumps are given a START command.
- The status of Condenser Pumps running is taken as feedback to the system to confirm the RUN status of Condenser Pump after which the Cooling Tower fans are given a start command.
- The status of Cooling Tower running is taken as feedback to the system to confirm the RUN status of Cooling Tower.
- Once the RUN status of any of the condenser pump and any of the Cooling Tower is confirmed as running along with the open status of any set of Chiller Isolation Valves the CHW Primary Pumps are given a START command.
- When the RUN status of any of the Condenser Pumps, Primary Pumps, and Cooling Towers is confirmed as running and the valves are confirmed as open, then the Chiller in sequence is given the START command.

C.3. EQUIPMENT STOP SEQUENCE

In case of STOP command or fault condition and a chiller stops, the following sequence will take place:

- The Condenser Water Pump having maximum runtime would be switched OFF.
- The Primary Chilled Water Pump having maximum runtime would be switched OFF.
- The Cooling Tower having maximum runtime would be switched OFF.
- The selected Chiller Condenser & Chilled Water Isolation valves will be closed.
- The Cooling Towers Isolation valves will be closed.

C.A. STAGE-UP & STAGE DOWN OF CHILLERS

C.4.1. "Stage-Up" Sequence

- The Lead is Water Cooled Chiller always remains ON
- The CPO will initiate the starting of the next chiller i.e. Lag 1 chiller when the chilled water return header temperature is not achieved i.e. more than 12 deg C (Set point is User Settable) AND if Lead chiller running Continuously at 90% (User settable) or more load for 10 minutes (User settable),
- Nos of Primary Pump running will always be equal to the nos. of Chillers running, to maintain an equal distribution of water.
- If any of the Chillers fails to RUN, then according to the sequence the command will be passed on to the next Chiller in the sequence,

C.4.2. "Stage-Down" Sequence

- The stopping of Lag 1 chiller will be done by the CPO when chilled water return header temperature is below the set point (User settable) AND if the chiller running continuously at 50% (User settable) load for 10 minutes (User settable).
- Lead Chiller will be automatically switched off by the Chillers microprocessor panel once the leaving chilled water supply temperature is achieved.

C.5. CONDENSER PUMPS & COOLING TOWERS

1. When chiller is enabled the associated Cooling Tower (decided by CPO) isolation valve shall be automatically commanded from CPO to open fully. Upon proof of the Cooling Tower isolation valve and Condenser Water for fully open, the Condenser Pump (selected by CPO) shall and operate continuously.
2. Upon Proof of Condense Pump operation, the Cooling Tower fan shall be enabled.
3. An operating Cooling Tower shall be disabled from the assigned Chiller when the chiller closes its condenser water isolation valve (located at the chiller). Software interlock shall - disable the Cooling Tower fan and Pump then shall close the Cooling Tower isolation valve fully.

C.6. PRIMARY VARIABLE PUMPS

1. Primary Pump sequence will be selected based on Run time basis.
2. Upon proof of evaporator pumps valve open the Primary Pump will be given an ON command.

C.7 EQUIPMENT SEQUENCING UNDER FAULT CONDITION

- During normal running, if any equipment "TRIPS" then the CPO will auto ON next equipment in sequence and will issue an "ON" command to it.
- During starting of any equipment, if the status is not confirmed for a predefined to time then also CPO will automatically select the next equipment in sequence and will issue an "ON" command to it.

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
			AI	AO	DI	DO	Soft IO	Monitor	Control	Alarm	FROM	TO		
A	WATER COOLED CHILLER - 3 Working & 1 Standby for Hospital, R&D 1 Working for OT	5												
1	Chiller On/Off Command					5			x		DDC	Panel	* Supply, laying & termination of cable from Panel terminal Block to DDC	NA
2	Chiller Auto/Manual status			5			x		x	Panel	DDC			
3	Chiller On/Off Status			5			x		x	Panel	DDC			
4	Chiller Trip Status			5					x	Panel	DDC			
5	Common Supply Header Temperature		1					x		Imm temp sensor	DDC	* Supply, Installation, Testing and Commissioning of Imm. Temp. Sensor with Thermo well. * Cable Laying from Imm. Temp. Sensor to DDC.. * Cable Termination at DDC & Field End. * Thermo well detail will be provided.	* Suitable provision for Thermo well installation in pipe to be provided	
6	Common return Header Temperature		1					x		Imm temp sensor	DDC			
7	Common Condenser Inlet Temperature		1					x		Imm temp sensor	DDC			
8	Common Condenser Outlet Temperature		1					x		Imm temp sensor	DDC			
9	Common Supply Header Pressure		1					x		Pressure Transmitter	DDC	* Supply, Installation, Testing and Commissioning of Pressure transmitter. * Cable Laying from Pressure transmitter to DDC..	Space/Hole Provision for transmitter in pipe to be provided	
10	Common return Header Pressure		1					x		Pressure Transmitter	DDC			

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
											* 24VAC power supply, Cable Termination at DDC & Field End.		
11	Chiller Evaporator Isolation Valve On/Off Command				5			x		DDC	Isolation Valve	* Supply, laying & termination of cable from Panel terminal Block to DDC	Isolation Valve with actuator to be Provided by HVAC Vendor
12	Chiller Evaporator Isolation Valve On/Off Status			5			x		x	Isolation Valve	DDC		
13	Chiller Condenser Isolation Valve On/Off Command				5			x		DDC	Isolation Valve	* Supply, laying & termination of cable from Panel terminal Block to DDC	Isolation Valve with actuator to be Provided by HVAC Vendor
14	Chiller Condenser Isolation Valve On/Off Status			5			x		x	Isolation Valve	DDC		
15	Flow switch on Supply Header			1			x		x	Flow Switch(water)	DDC	* Supply & installation of Flow Switch. * Supply, laying & termination of cable from Flow Switch to DDC	Space/Hole Provision for flow switch transmitter in pipe to be provided
16	Flow Meter at Return Header	2											
17	Chiller's VFD Command				5			x		Chiller Plant Manager-"CPM" (Through BACNET over IP)	DDC with Third party Integrator	* Provision of LAN point for CPM, *Cat 6 cable Laying from CPM to Lan point *Integration of BACnet IP controller in BMS Station.	* Supply, Installation, Testing and Commissioning of BACNET IP Controllers and Chiller Equipment's. * supply & installation of Chiller Manager field
18	Chiller's VFD Bypass Status				5		x						
19	Chiller's VFD Speed Feedback				5		x						
20	Chiller's VFD Frequency				5		x						
21	Chiller's VFD Current				5		x						
22	Chiller's VFD Voltage				5		x						
23	Chiller's VFD Power				5		x						
24	Chiller's VFD Run Time				5		x						
25	Condenser inlet Pressure				5		x						

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	I/O DETAILS					I/O Type		Connectivity		BMS Scope	HVAC Scope
26	Condenser outlet Pressure					5	x					devices. *Supply, laying & termination of cable for field devices * CPM object list to be provided after the commissioning of CPM system. *provision for BMS Field equipment locations to be specified
27	Compressor Suction Pressure					5	x					
28	Compressor Discharge Pressure					5	x					
29	Compressor Current Feedback					5	x					
30	Compressor Power Feedback					5	x					
31	IKW/Tr (Calculated by BMS Software)					5	x					
32	Compressor Loading Status					5	x					
33	individual chiller Supply Header Temp					5	x					
34	individual chiller return Header Temp					5	x					
35	individual chiller Condenser Inlet Temp					5	x					
36	individual chiller Condenser Outlet Temp					5	x					
	Sub Total		8	0	2	1	10					
B	Condensor Pump 3 Working & 1 Standby for Hospital, R&D 1 Working & 1 Standby for OT											
36	Condenser Pump Auto/Manual Status			6			x	x	Panel	DDC	* Supply, laying & termination of cable from Panel terminal Block to DDC	NA
37	Condenser Pump On/Off Command	6			6			x	DDC	Panel		
38	Condenser Pump Trip Status			6					x	Panel			DDC
39	Condenser Pump On/Off			6			x	x	DP Switch(w	DDC	* Supply & installation	Space/Hole

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	I/O DETAILS				I/O Type	Connectivity		BMS Scope	HVAC Scope	
	Status							ater)	of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	Provision for DP switch transmitter in pipe to be provided	
	Sub Total	0	0	18	6						
C	Cooling Tower (3 Working & 1 standby for Hospital & R&D block and 1 working and 1 standby for OT										
40	Cooling Tower Fan On/Off Command	5			10		x	DDC	Panel	* Supply, laying & termination of cable from Panel terminal Block to DDC	NA
41	Cooling Tower Fan On/Off Status			10		x	x	DP Switch	DDC		
42	Cooling tower fan Trip Status			10			x	Panel	DDC		
43	cooling tower Fan Auto/Manual Status			10		x	x	Panel	DDC		
44	Cooling Tower Isolation Valve On/Off Command				5		x	DDC	Isolation Valve	* Supply, laying & termination of cable from Valve terminal Block to DDC	Isolation Valve with actuator to be Provided by HVAC Vendor
45	Cooling Tower Isolation Valve On/Off Status			5		x	x	Isolation Valve	DDC		
46	Bypass valve status			5		x		Valve	DDC	* Supply, laying & termination of cable from Valve terminal Block to DDC	Valve with actuator to be provided
47	Cooling Tower Sump Water Low Level			5			x	Level switch	DDC	* Supply, Installation, Testing and Commissioning of Level switch. * Cable laying from Level switch to DDC.	* Suitable provision for Level switch installation to be provided, sump level to be informed

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	I/O DETAILS						I/O Type			Connectivity	BMS Scope	HVAC Scope
												* Cable Termination at DDC & Field End.	prior to procurement
48	Cooling Tower Water Temperature		5					x		Imm temp sensor	DDC	* Supply, Installation, Testing and Commissioning of Imm. Temp. Sensor with Thermo well. * Cable Laying from Imm. Temp. Sensor to DDC.. * Cable Termination at DDC & Field End. * Thermo well detail will be provided.	* Suitable provision for Thermo well installation in sump to be provided
49	Cooling tower fan speed command			10					x	DDC	CT FAN Panel	* Supply, laying & termination of cable from Panel terminal Block to DDC	NA
50	Cooling tower fan speed Feedback		10					x		CT FAN Panel	DDC		
51	Make up tank Level	1	1					x		Level Transmitter	DDC	* Supply, Installation, Testing and Commissioning of Level Transmitter with power supply unit * Cable laying from Level Transmitter to DDC. * Cable Termination at DDC & Field End.	* Suitable provision for Level Transmitter installation to be provided
52	Over head tank Level	1	1					x		Level Transmitter	DDC	* Supply, Installation, Testing and Commissioning of Level Transmitter with power supply unit	* Suitable provision for Level Transmitter installation to be provided

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	I/O DETAILS						I/O Type			Connectivity		BMS Scope	HVAC Scope
												* Cable laying from Level Transmitter to DDC. * Cable Termination at DDC & Field End.		
53	Expansion tank pressure monitoring	1	1					x		Pressure Transmitter	DDC	* Supply, Installation, Testing and Commissioning of Pressure Transmitter with power supply unit* Cable laying from Pressure Transmitter to DDC.* Cable Termination at DDC and Pressure Transmitter End.* Pressure Transmitter details will be provided.	* Suitable provision for Pressure Transmitter installation at expansion tank to be provided	
54	Outside Air Temperature Monitoring		1					x		OA Temperature Sensor	DDC	*Supply & installation of Temp Sensor, *Supply, laying & termination of cable from Temp Sensor to DDC	Space/Hole Provision for Temp Sensor to be provided	
55	Outside Air Relative Humidity monitoring		1					x		OA Humidity Sensor	DDC	* Supply & installation of RH Sensor. *Supply, laying & termination of signal and 24VAC power cable from RH Sensor to DDC.	Space/Hole Provision for RH Sensor to be provided	

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	I/O DETAILS						I/O Type			Connectivity		BMS Scope	HVAC Scope
56	Ambient CO ₂ level	1						x			OA CO ₂ Sensor	DDC	* Supply & installation of CO ₂ Sensor. *Supply, laying & termination of signal and 24VAC power cable from CO ₂ Sensor to DDC.	Space/Hole Provision for CO ₂ Sensor to be provided
Sub Total		21	10	45	15	0								
D	Primary Variable Pump 3 Working & 1 Standby for Hospital, R&D1 Working & 1 Standby for OT	6												
1	Primary Pump On/Off Command				6			x			DDC	Panel	* Supply, laying & termination of cable from Panel terminal Block to DDC	NA
2	Primary Pump Trip Status			6					x		Panel	DDC		
3	Primary Pump Auto/Manual Status			6			x	x			Panel	DDC		
4	Primary Pump Run Status			6				x	x		DP Switch(water)	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	Space/Hole Provision for DP switch transmitter in pipe to be provided
5	Primary Pump's VFD Command				6			x			DDC	VFD Panel	* Supply, laying & termination of cable from VFD terminal Block to DDC	NA
6	Primary Pump's VFD Bypass Status			6			x				VFD Panel	DDC		
7	Primary Pump's VFD Speed control		6					x			DDC	VFD Panel	* 0-10Vdc control signal for 0-100% speed modulation to be provided. * Cable	NA

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	I/O DETAILS				I/O Type	Connectivity		BMS Scope	HVAC Scope
								laying from DDC to VFD. * Cable Termination at VFD & DDC End.		
8	Pressure Sensor for pump load estimation	1				x	Pressure Transmitter	DDC	* Supply, Installation, Testing and Commissioning of Pressure transmitter. * Cable Laying from Pressure transmitter to DDC.. * 24VAC power supply, Cable Termination at DDC & Field End.	Space/Hole Provision for transmitter in pipe to be provided
	Sub Total	1	6	2	4	1	2			
E	Monsoon ReHeat 2 Working and 1 standby and Hot Water Generators 2 Working and 1 standby	6								
1	Heat Pump & Hot Water Generator On/Off Command					6				
2	Heat Pump & Hot Water Generator Run Status				6					
3	Heat Pump & Hot Water Generator Trip Status				6					
4	Heat Pump & Hot Water Generator				6					

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	I/O DETAILS						I/O Type		Connectivity		BMS Scope	HVAC Scope
	Auto/Manual Status												
5	Heat Pump & Hot Water Generator Main header Inlet & Outlet Temperature Feedback	4											
6	Heat Pump & Hot Water Generator Individual Outlet Temp. Feedback	6											
8	Heat Pump & Hot Water Generator Isolation Valves Open / Close Command				6								
9	Heat Pump & Hot Water Generator Isolation Valves Open / Close Status			6									
10	Heat Pump & Hot Water Generator microprocessor (software) integration for HWG-intrinsic parameter monitoring (15 points per HWG)					90							
	Sub Total	10	24	12	45								
F	Primary Variable Pump 2 Working & 1 Standby for Monsoon Reheat	3											
1	Primary Pump On/Off Command				3		x		DDC	Panel	* Supply, laying & termination of cable from Panel terminal Block to DDC	NA	
2	Primary Pump Trip Status			3				x	Panel	DDC			
3	Primary Pump Auto/Manual			3			x	x	Panel	DDC			

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	I/O DETAILS						I/O Type			Connectivity		BMS Scope	HVAC Scope
	Status													
4	Primary Pump Run Status			3				x	x	DP Switch(water)	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	Space/Hole Provision for DP switch transmitter in pipe to be provided	
5	Primary Pump's VFD Command				3				x	DDC	VFD Panel	* Supply, laying & termination of cable from VFD terminal Block to DDC	NA	
6	Primary Pump's VFD Bypass Status			3				x		VFD Panel	DDC			
7	Primary Pump's VFD Speed control			3					x	DDC	VFD Panel	* 0-10Vdc control signal for 0-100% speed modulation to be provided. * Cable laying from DDC to VFD. * Cable Termination at VFD & DDC End.	NA	
8	Pressure Sensor for pump load estimation		1						x	Pressure Transmitter	DDC	* Supply, Installation, Testing and Commissioning of Pressure transmitter. * Cable Laying from Pressure transmitter to DDC.. * 24VAC power supply, Cable Termination at DDC & Field End.	Space/Hole Provision for transmitter in pipe to be provided	
	Sub Total		13	12	6									
	Total		41	149	66	145								
	SPARE	2	84	31	29									

CHILLER PLANT OPTIMIZER IO SUMMARY

SI. NO	PARTICULARS	0 %	I/O DETAILS				I/O Type	Connectivity	BMS Scope	HVAC Scope
			0	3	7	17				
			4	2	1	7				
	Grand total		9	3	7	9				

Legends:

- PFC-Potential free contact(NO/NC contact)
- DDC-Direct Digital controller
- LCP -Local Control Panel (electrical starter panel)
- DP switch-Differential pressure switch

BBB. TECHNICAL SPECIFICATIONS - BUILDING MANAGEMENT SYSTEM (BMS)

1.0 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES:

1.1 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

BMS Building Management System

GUI Graphical User Interface

POT Portable Operator's Terminal

DDC Direct Digital Controls

LAN Local Area Network

PICS Product Interoperability Compliance Statement

OPERATION & MAINTENANCE by contractor for a period of 6 months

At the close of the work and after the issue of final certificate, the contractor will operate & maintain (the complete HVAC system including BMS system for a period of six month). During the period the contractor will also train the AAHII technical operational staffs.

1.2 ARCHITECTURE:

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet, and Modbus technology communication protocols in an interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995, BACnet TCP to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet at all levels.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. **Components or controllers requiring "polling" by a Master / Global / Host to pass data shall not be acceptable.**
- D. Structured Query Language (SQL) or Java Database Connectivity (JDBC) or ORACLE compliant server database is required for all system database parameter storage. This data shall reside on a server for all database access. **Systems requiring proprietary database and user interface programs shall not be acceptable.**
- E. Two (2) level hierarchical topology is required to assure fast system response times and to manage the flow and sharing of data. Systems Requiring Router, Gateways are not acceptable.

1.3 WEB BROWSER CLIENTS

The system shall be capable of supporting an unlimited number of users using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. **Systems requiring additional software (to enable a standard Web browser) to be resident on the DDC / client machine, or manufacture-specific browsers shall not be acceptable.** The Web browser software shall run on any operating system and system configuration that is supported by the Web browser.

The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

The Web browser client shall support at a minimum, the following functions:

User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

Graphical screens developed for the GUI shall be the same screens used for the Web browser client.

HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

Storage of the graphical screens (Static) shall be stored in DDC directly and should not depend on any other hardware.

The Web page shall get automatically refreshed without any user intervention.

Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

Modify common application objects, such as schedules, calendars, and set points in a graphical manner. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator and set holidays

View logs and charts

View and acknowledge alarms

The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to adjust their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

1.4 SYSTEM DESCRIPTION & INPUT OUTPUT SUMMARY

The proposed system shall be a Direct Distributed Digital Control (DDC) system. It shall be a PC based system and shall combine latest state of the art technology with simple operating techniques. The entire Monitoring of Building Management System (BMS) shall be comprise of a network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility and communicating via the Internet to a host computer in a remote location. The BMS shall communicate to third party systems such as Chillers, VAVs, Energy meters, UPS, DG, Lifts, VFDs & HT/LT circuit breakers, access control systems, fire-life safety systems and other building management related devices with open, interoperable communication capabilities.

The BMS framework shall utilize built-in Internet connectivity to a broad range of distribution partners in the building automation, energy services, power/utility, and industrial sectors. The Framework shall bring together the ongoing computerization of control applications under single integrated system architecture.

The features shall be distributed both physically and functionally over the field controllers. Microprocessor based Direct Digital Distributed Controllers (DDC) shall interface with sensors, actuators and environmental control systems (i.e. HVAC units, chillers, pumps, fans, lighting etc.) and carry out followings functions:

- a. Individual input/output point scanning, processing and control.
- b. Centralized operation of the plant (remote control).
- c. Static / Dynamic graphic details of plant and building.
- d. Energy Management through optimization of all connected electrical and mechanical plants.
- e. Alarm Detection and early recognition of faults.
- f. Time, event and holiday scheduling as well as temporary scheduling.

- g. Prevention of unauthorized or unwanted access.
- h. Communication interface and control.
- i. Suggestive preventive maintenance for all equipment as well as own error diagnosis.
- j. Report generation.
- k. Optimum support of personnel.
- l. Data Visualization Tool

These Controllers shall be capable of functioning on a stand-alone mode i.e. in case of loss of communication with the central control station / Server, these shall function independently. DDC shall have microprocessors built-in as standard, which control the respective operation centers based on the required logic and also offer fast communication of data via the network communication system. The local access to these shall be either through an in-built display with keypad for each outstation or through a portable operator's terminal. The controllers shall be capable of executing advanced control algorithms like Optimum Start stop, PID control, auto PID tuning and schedule management. They shall also execute logic functions based on time and/or event. Totalization and averaging functions shall be an inherent feature of the controller.

Each stand-alone intelligent DDC Controller shall have a **dual 32 bit processor**, on board Ethernet connectivity. These shall also control any other operations on the floor and shall be sized to suit the operation centres or system requirement. This shall help in reducing the site electrical installation.

The number of controllers for central plant room equipments shall be decided by the contractor. Overall, the system shall be provided with 20% spare capacity, with spare of at least 20% points on each controller.

There shall be one BMS control station located in Control Room. The Operator Station should use a simple Web Browser in conjunction with the BMS Server software. The Computer shall be sized to cover the graphic display memory, planning information, software & data storage requirement. The display shall be in the form of dynamic color graphics and text format with menu driven pop-up windows and help facility.

The following software packages shall be loaded into the system as minimum standard:-

- a. Complete system operational software
- b. Site specific data manipulation software
- c. Graphics software
- d. Alarm indication software
- e. Internet Enabled Remote Monitoring Package.

NIT No- AGIHF/Executing Agency/2024-25/01 date 27.08.2024

DI=DIGITAL INPUT; AI=ANALOG INPUT; DO=DIGITAL OUTPUT; AO=ANALOG OUTPUT

Insert Project IO Summary or provide the same as spare annexure.

BMS															
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope	
			AI	AO	DI	DO	Soft IO	Monitor	Control	Alarm	FROM	TO			
A	FLOOR MOUNTED AIR HANDLING UNIT WITH SINGLE COIL & VFD (37 Nos) HOSPITAL BLOCK & 8 NOS AHU R&D BLOCK	45													
1	FAHU Fan On/Off Command					45				x		DDC	LCP	* Supply, laying & termination of cable from LCP terminal Block to DDC	NA
2	FAHU Motor trip status				45						x	LCP	DDC		
3	FAHU Auto/Manual Status				45				x		x	LCP	DDC		
4	FAHU's VFD Command					45					x	DDC	VFD	* Supply, laying & termination of cable from VFD terminal Block to DDC	NA
5	FAHU's VFD/Bypass Status				45				x			VFD	DDC		
6	FAHU's VFD Speed feed back			45								VFD	DDC	* DDC will required 0-10Vdc signal for 100% VFD Speed feedback. * Supply, laying & termination of cable from DDC to VFD.	NA
7	FAHU's VFD Speed Control				45							DDC	VFD	* 0-10Vdc control signal for 0-100% speed modulation to be provided. * Supply, laying	NA

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
													& termination of cable from DDC to VFD Terminal Block.	
8	FAHU Fan Run Status				45			x		x	DP Switch	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	* Space/Hole Provision for DP Switch across Supply Fan
9	Pressure Drop across ESP Filter				45						ESP	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	* Space/Hole Provision for DP Switch across Pre Filter
12	Return Air Temperature Monitoring		45					x			Temperature Sensor(Duct)	DDC	* Supply & installation of Temp Sensor. * Supply, laying & termination of cable from Temp Sensor to DDC	* Space/Hole Provision for Temp Sensor in Return Air
13	Chilled Water Control Valve Modulation Command				45					x	DDC	Modulating Valve	*0-10Vdc control signal for 0-100% valve modulation to be provided. * Supply, laying & termination of cable from DDC to Valve Actuator. * 24VAc Power	* Supply & installation of Modulating Valve. * Modulating type valve with feedback & 0 to 10V dc Output for BMS Monitoring & Control

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
													supply to valve actuator from DDC Panel.	
14	Chilled Water Control Valve Feedback		45					x			Modulating Valve	DDC	* DDC will required 0-10Vdc signal for 100% valve position feedback. * Supply, laying & termination of cable from DDC to Valve Actuator.	
15	Duct Supply Static Pressure Feedback		45					x			Pressure transmitter(duct static)	DDC	* Supply & installation of Pressure Transmitter, * Supply, laying & termination of cable from Pressure Transmitter to DDC. *24VAC Power supply to Pressure Transmitter from DDC Panel.	* Space/Hole Provision for Pressure transmitter in Supply Air Duct.
17	Fresh Air Damper control			45					x		DDC	Modulating Damper	* Supply, laying & termination of cable from Fresh Air Damper to DDC.	* Supply & installation of fresh air damper.
18	Fresh Air Damper feedback		45					x			Modulating	DDC		* Modulating type damper with 0-

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
											Damper			10V dc Output & feedback for BMS Monitoring & Control *Tapping of Power from Power Socket
20	Supply Air Fire Damper Status				45			x			Fire Damper	DDC	* Supply, laying & termination of cable from Fire Damper to DDC.	* Supply & installation of fire damper. * Modulating type damper with feedback for BMS Monitoring *Tapping of Power from Power Socket
21	Return Air Fire Damper Status				45			x			Fire Damper	DDC	* Supply, laying & termination of cable from Fire Damper to DDC.	* Supply & installation of fire damper. * Modulating type damper with feedback for BMS Monitoring *Tapping of Power from Power Socket
	Total		225	135	315	90	0							
B	CRITICAL FLOOR MOUNTED AIR HANDLING UNIT 36 Nos FOR HOSPITAL BLOCK AND 8 Nos FOR OT BLOCK)	44												
1	FAHU Fan On/Off Command				44			x			DDC	LCP		
2	FAHU Motor trip status				44					x	LCP	DDC		
3	FAHU Auto/Manual Status				44			x		x	LCP	DDC		

BMS													
SI.NO	PARTICULARS		I/O DETAILS				I/O Type			Connectivity		BMS Scope	HVAC Scope
4	FAHU's VFD Command				44			x		DDC	VFD		
5	FAHU's VFD/Bypass Status			44				x		VFD	DDC		
6	FAHU's VFD Speed feed back		44					x		VFD	DDC		
7	FAHU's VFD Speed Control			44					x	DDC	VFD		
8	FAHU Fan Run Status			44				x		DP Switch	DDC		
9	Pressure Drop across ESP Filters			44						ESP	DDC		
11	Supply Air Temperature Monitoring		44					x		Temperature Sensor(Duct)	DDC		
12	Return Air Temperature Monitoring		44					x		Temperature Sensor(Duct)	DDC		
13	Chilled Water Control Valve Modulation Command			44					x	DDC	Modulating Valve		
14	Chilled Water Control Valve Feedback		44					x		Modulating Valve	DDC		
13	HOT Water Control Valve Modulation Command			44					x	DDC	Modulating Valve		
14	HOT Water Control Valve Feedback		44					x		Modulating Valve	DDC		
15	Duct Supply Static Pressure Feedback		44					x		Pressure transmitter(duct static)	DDC		
16	Return Air CO ₂ level		44					x		CO ₂ Sensor(D	DDC		

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
											uct)			
17	Fresh Air Damper control			44					x		DDC	Modulating Damper		
18	Fresh Air Damper feedback		44					x			Modulating Damper	DDC		
19	Return Air Relative Humidity monitoring		44					x			Humidity Sensor(Duct)	DDC		
20	Supply Air Fire Damper Status				44			x			Fire Damper	DDC		
21	Return Air Fire Damper Status				44			x			Fire Damper	DDC		
22	Hot Water Inlet Temperature Monitoring		44					x			Imm temp sensor	DDC		
23	Chilled Water Outlet Temperature Monitoring		44					x			Imm temp sensor	DDC		
	Total		484	176	308	88	0							
C	2 Nos CRITICAL FLOOR MOUNTED AIR HANDLING UNIT FOR OT'S WITH 100% FA & DX COIL & RECOVERY WHEEL	2												
1	FAHU Fan On/Off Command					2			x		DDC	LCP		
2	FAHU Motor trip status				2					x	LCP	DDC		
3	FAHU Auto/Manual Status				2			x		x	LCP	DDC		
4	FAHU's VFD Command					2			x		DDC	VFD		

BMS													
SI.NO	PARTICULARS		I/O DETAILS				I/O Type			Connectivity		BMS Scope	HVAC Scope
5	FAHU's VFD/Bypass Status				2			x			VFD	DDC	
6	FAHU's VFD Speed feed back		2					x			VFD	DDC	
7	FAHU's VFD Speed Control			2					x		DDC	VFD	
8	FAHU Fan Run Status				2			x		x	DP Switch	DDC	
9	Pressure Drop across HEPA Filter		2							x	Pressure transmitter(duct static)	DDC	
10	Pressure Drop across ESP Filters				2					x	ESP	DDC	
11	Supply Air Temperature Monitoring		2					x			Temperature Sensor(Duct)	DDC	
12	Fresh Air Temperature Monitoring		2					x			Temperature Sensor(Duct)	DDC	
13	Chilled Water Control Valve Modulation Command			2					x		DDC	Modulating Valve	
14	Chilled Water Control Valve Feedback		2					x			Modulating Valve	DDC	
13	HOT Water Control Valve Modulation Command			2					x		DDC	Modulating Valve	
14	HOT Water Control Valve Feedback		2					x			Modulating Valve	DDC	
15	Duct Supply Static Pressure Feedback		2					x			Pressure transmitter(duct static)	DDC	

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
16	Fresh Air CO ₂ level		2					x			CO2 Sensor(Duct)	DDC		
17	Fresh Air Damper control			2					x		DDC	Modulating Damper		
18	Fresh Air Damper feedback		2					x			Modulating Damper	DDC		
19	Supply and Fresh Air Relative Humidity monitoring		4					x			Humidity Sensor(Duct)	DDC		
20	Supply Air Fire Damper Status				2			x			Fire Damper	DDC		
21	Return Air Fire Damper Status				2			x			Fire Damper	DDC		
22	Hot Water Inlet Temperature Monitoring		2					x			Imm temp sensor	DDC		
23	Chilled Water Outlet Temperature Monitoring		2					x			Imm temp sensor	DDC		
	DX PACKAGED UNIT													
	DX COIL Supply Fan On/Off Command				2									
	DX COIL Motor trip status				2									
	DX COIL Run Status				2									
	DX COIL Filter Status				2									
	Total		26	8	20	6	0							
D	HEAT RECOVERY UNIT (6 Nos for Hospital Block & 2 Nos for R&D Block)	8												
1	Fresh Air Fan On/Off Command				8				x		DDC	PANEL	* Supply, laying & termination of	NA

BMS															
SI.NO	PARTICULARS		I/O DETAILS				I/O Type			Connectivity		BMS Scope	HVAC Scope		
2	Fresh Air Fan Motor Trip sts				8				x	PANEL	DDC	cable from LCP terminal Block to DDC			
3	Fresh Air Fan Auto/Manual Status				8		x		x	PANEL	DDC				
4	Fresh Air Fan Run Status				8			x		x	PANEL	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	Space/Hole Provision for DP Switch across Supply Fan	
5	Fresh Air Damper control								x		DDC	DAMPER	* Supply, laying & termination of cable from Fresh Air Damper to DDC.	Supply & installation of fresh air damper. Modulating type damper with feedback & 0 to10 V O/P for BMS Monitoring & Control	
6	Fresh Air Damper feedback				8			x			DAMPER	DDC			
7	Fresh Air Header Pressure Status				8						x	Pressure transmitter(duct static)	DDC	* Supply & installation of Pressure Transmitter, * Supply, laying & termination of cable from Pressure Transmitter to DDC. *24VAC Power supply to Pressure Transmitter from DDC Panel.	Space/Hole for Pressure transmitter probe insertion to be provided.

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
8	Fresh Air Temperature Monitoring		8					x			Temperature Sensor(Duct)	DDC	* Supply & installation of Temp Sensor. * Supply, laying & termination of cable from Temp Sensor to DDC	Space/Hole Provision for Temp Sensor in AHU
9	Fresh Air Fan VFD Command			8					x		DDC	VFD Panel	* Supply, laying & termination of cable from VFD terminal Block to DDC	NA
10	Fresh Air Fan VFD Bypass sts				8			x			DDC	VFD Panel		
11	Fresh Air Fan VFD Speed Control			8					x		DDC	VFD	* 0-10Vdc control signal for 0-100% speed modulation to be provided. * Supply, laying & termination of cable from DDC to VFD Terminal Block.	NA
12	Exhaust Air Fan On/Off Command					8			x		DDC	PANEL	* Supply, laying & termination of cable from LCP terminal Block to DDC	NA
13	Exhaust Air Fan Motor Trip sts				8					x	PANEL	DDC		
14	Exhaust Air Fan Auto/Manual Status				8			x		x	PANEL	DDC		
15	Exhaust Air Fan Run Status				8			x		x	PANEL	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	Space/Hole Provision for DP Switch across Supply Fan
16	Exhaust Air Damper control				8				x		DDC	DAMPER	* Supply, laying & termination of cable from	Supply & installation of fresh air damper.
17	Exhaust Air Damper				8			x			DAMPER	DDC		

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
	feedback												Exhaust Air Damper to DDC.	Modulating type damper with feedback & 0 to10 V O/P for BMS Monitoring & Control
18	Exhaust Air Header Pressure Status		8								Pressure transmitter(duct static)	DDC	* Supply & installation of Pressure Transmitter,* Supply, laying & termination of cable from Pressure Transmitter to DDC.*24VAC Power supply to Pressure Transmitter from DDC Panel.	Space/Hole for Pressure transmitter probe insertion to be provided.
19	Exhaust Air Temperature Monitoring		8					x			Temperature Sensor(Duct)	DDC	* Supply & installation of Temp Sensor. * Supply, laying & termination of cable from Temp Sensor to DDC	Space/Hole Provision for Temp Sensor in AHU
20	Exhaust Air Fan VFD Command			8					x		DDC	VFD Panel	* Supply, laying & termination of cable from VFD terminal Block to DDC	NA
21	Exhaust Air Fan VFD Bypass sts				8			x			DDC	VFD Panel		
22	Exhaust Air Fan VFD Speed Control			8					x		DDC	VFD	* 0-10Vdc control signal for 0-100% speed modulation to be provided. * Supply, laying & termination of	NA

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
													cable from DDC to VFD Terminal Block.	
23	Exhaust Air Temperature Status - After Heat Recovery Wheel		8							Temperature Sensor(Duct)	DDC		* Supply & installation of Temp Sensor. * Supply, laying & termination of cable from Temp Sensor to DDC	Space/Hole Provision for Temp Sensor in AHU
	Total		40	32	88	16	0							
E	Supply / Exhaust / Smoke extraction fan	33												
1	Fan On/Off command					33			x		DDC	Panel	* Supply, laying & termination of cable from LCP terminal Block to DDC	NA
2	Fan On/Off status				33			x		x	Panel	DDC		
3	Fan Trip status				33					x	Panel	DDC		
4	Fan A/M status				33			x		x	Panel	DDC		
	Total		0	0	99	33	0							
F	STAIRCASE & LIFTWELL PRESSURIZATION FAN	25												
1	Fan On/Off command					25			x		DDC	Panel	* Supply, laying & termination of cable from LCP terminal Block to DDC	NA
2	Fan On/Off status				25			x		x	Panel	DDC		
3	Fan Trip status				25					x	Panel	DDC		
4	Fan A/M status				25			x		x	Panel	DDC		
	Total		0	0	75	25	0							

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
G	AXIAL FAN	53												
1	Fan On/Off command				53			x		DDC	Panel	* Supply, laying & termination of cable from LCP terminal Block to DDC	NA	
2	Fan On/Off status			53			x	x	Panel	DDC				
3	Fan Trip status			53				x	Panel	DDC				
4	Fan A/M status			53			x	x	Panel	DDC				
	Total		0	0	159	53	0							
H	CENTRIFUGAL CABINET FAN	15												
1	On/Off command				15			x		DDC	Panel	Cable laying & termination from PANEL terminal Block to DDC	NA	
2	Trip status			15				x	Panel	DDC				
4	On/Off status			15			x	x	Panel	DDC				
	Total		0	0	30	15	0							
I	Air Washer	2												
1	Fan On/Off Command				2									
2	Fan Auto/Manual Status			2										
3	Fan Run Status			2										
4	Pump On/Off Command & Feedback			2	2									
5	Pump Auto/Manual Status			2										
	Total IO Points Air Washer		0	12	0	6	0							
J	Dry Scrubber	2												
1	Fan On/Off Command				2									
2	Fan Auto/Manual Status			2										
3	Fan Run Status			2										
	Total IO Points Scrubber		0	2	0	1	0							

BMS													
SI.NO	PARTICULARS		I/O DETAILS				I/O Type			Connectivity		BMS Scope	HVAC Scope
K	STP PLC Modbus integration												
1	PLC Pumps On/Off Status	2				2	x		x	STP PLC	DDC	* Supply, Installation, Testing & Commissioning of Modbus Integrator. * Modbus RS-485 Cable laying from Integrator to PLC. * Cable Termination at Integrator End.	NA
2	Pumps Trip Status				2			x					
3	Sewage Flow monitoring				2	x							
4	Dissolved Oxygen level monitoring in Domestic Water				2	x							
5	Level Transmitter Monitoring				2	x							
	TOTAL		0	0	0	0	10						
L	HYDRO PNEUMATICS PUMPS (terrace, Filter Feed, Raw water, Drainage Pump, Heat Pump, Rain Water, Fire Pump)	28											
1	Pump On/Off Command				28			x		DDC	Panel	* Cable laying & Termination from DDC to Panel for BMS integration.	NA
2	Pump On/Off Status			28			x	x	Panel	DDC			
3	Pump Trip Status			28				x	Panel	DDC			
4	Pump A/M Status			28			x	x	Panel	DDC			
	TOTAL		0	0	84	28	0						
M	FIRE FIGHTING SYSTEMS												

BMS														
SI.NO	PARTICULARS		I/O DETAILS				I/O Type			Connectivity		BMS Scope	HVAC Scope	
1	Sprinkler Header Pressure Monitoring		1					x			Pressure Transmitter	DDC	* Cable laying from DDC to Panel * Cable Termination at DDC End.	NA
2	Hydrant Header Pressure Monitoring		1					x			Pressure Transmitter	DDC	* Cable laying from DDC to Panel * Cable Termination at DDC End.	NA
i	Main Pump-Sprinkler and Hydrant	2												
1	Pump On/Off Status				2			x	x	Panel	DDC	* Cable laying from DDC to Panel * Cable Termination at DDC End.	NA	
2	Pump Trip Status				2				x	Panel	DDC			
3	Pump A/M Status				2		x	x	Panel	DDC				
4	Pump Dry Run Alarm status				2				x	Panel	DDC			
5	Pump Run Status				2			x	x	DP Switch(water)	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	NA	
ii	JOCKEY Pump-Sprinkler and Hydrant	2												
1	Pump On/Off Status				2			x	x	Panel	DDC	* Cable laying from DDC to Panel * Cable Termination at	NA	
2	Pump Trip Status				2				x	Panel	DDC			
3	Pump A/M Status				2		x	x	Panel	DDC				
4	Pump Dry Run Alarm status				2				x	Panel	DDC			

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
													DDC End.	
5	Pump Run Status				2			x		x	DP Switch(w ater)	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	NA
iii	Booster pump-Terrace													
1	Pump On/Off Status				2			x		x	Panel	DDC	* Cable laying from DDC to Panel * Cable Termination at DDC End.	NA
2	Pump Trip Status				2					x	Panel	DDC		
3	Pump A/M Status				2			x		x	Panel	DDC		
4	Pump Dry Run Alarm status				2					x	Panel	DDC		
5	Pump Run Status				2			x		x	DP Switch(w ater)	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	NA
iv	Stand by Pumps Diesel driven	2												
1	Pump On/Off Status				2			x		x	Panel	DDC	* Cable laying from DDC to Panel * Cable Termination at DDC End.	NA
2	Pump Trip Status				2					x	Panel	DDC		
3	Pump A/M Status				2			x		x	Panel	DDC		
4	Pump Dry Run Alarm status				2					x	Panel	DDC		
5	Pump Run Status				2			x		x	DP Switch(w ater)	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	NA

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
v	Fire Water Pumps for Foam System													
1	Pump On/Off Status				0			x		x	Panel	DDC	* Cable laying from DDC to Panel * Cable Termination at DDC End.	NA
2	Pump Trip Status				0					x	Panel	DDC		
3	Pump A/M Status				0		x		x	Panel	DDC			
4	Pump Dry Run Alarm status				0					x	Panel	DDC		
5	Pump Run Status				0			x		x	DP Switch(w ater)	DDC	* Supply & installation of DP Switch. * Supply, laying & termination of cable from DP Switch to DDC	NA
	TOTAL		2	0	40	0	0							
N	UG (6 Nos.) & OH (35 Nos.) Tanks	10												
1	UG Water Tanks Level	3			3					x	level		* Supply, Installation, Testing & Commissioning of Modbus Integrator. * Modbus RS-485 Cable laying from Integrator to Panel * Cable Termination at Integrator End.	NA
2	OH Water Tanks Level	7			7					x				
											x			
	Total		0	0	10	0	0							
O	SUBSTATION EQUIPMENTS									x				

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
1	HT Panel I/C On/Off Status	1			1			x		x	HT Panel	DDC	* Cable laying & Termination from DDC to Panel for BMS integration.	NA
2	HT Panel I/C Trip Status				1					x	HT Panel	DDC		
3	HT Panel O/G On/Off Status	1			1			x		x	HT Panel	DDC	* Cable laying & Termination from DDC to Panel for BMS integration.	NA
4	HT Panel O/G Trip Status				1					x	HT Panel	DDC		
5	HT Panel Bus Coupler On/Off Status				0			x		x	HT Panel	DDC	* Cable laying & Termination from DDC to Panel for BMS integration.	NA
6	HT Panel Bus Coupler Trip Status				0					x	HT Panel	DDC		
7	HT Transformer oil Temperature sensor	3	1								Oil Temperature Sensor	DDC	* Supply & installation of Temp Sensor. * Supply, laying & termination of cable from Temp Sensor to DDC	NA
28	LT Panel I/C Breaker On/Off Status	1			1			x		x	Main Panel's PLC	DDC	* Cable laying & Termination from DDC to Panel for BMS integration.	NA
29	LT Panel I/C Breaker Trip Status				1					x	Main Panel's PLC	DDC		
30	LT Panel O/G Breaker On/Off Status	19			19			x		x	Main PCC Panel	DDC	* Cable laying & Termination from DDC to Panel for BMS integration.	NA
31	LT Panel O/G Breaker Trip Status				19					x	Main PCC Panel	DDC		
	TOTAL		1	0	44	0	0							
P	VAV units	255												
1	VAV Zone Temperature Set Point						255	x			VAV	DDC with Third party Integrator	* Supply, Installation, Testing & Commissioning of Modbus Integrator.	* Modbus RTU RS-485 to be provided. * Provision for Cable Entry *Supply &
2	VAV Zone Temperature						255	x						
3	VAV Damper opening						255	x						

BMS													
SI.NO	PARTICULARS		I/O DETAILS				I/O Type			Connectivity		BMS Scope	HVAC Scope
4	Pressure across VAV unit					255	x					* Supply, laying & termination of Modbus RS-485 Cable from Integrator to VAVs	installation of VAV Boxes & its related accessories like VAV controller, thermostat, actuator etc.,. *Cabling from VAV Controller to thermostat. *Tapping & cabling of Power from Power Socket
5	VAV Actual Flow Rate of Actuator					255	x						
6	VAV Actuator Warning Signal					255	x						
7	VAV Modulating signal(2-10v) Output in %					255	x						
8	VAV Economy/Normal Mode Status					255	x						
	Total		0	0	0	0	2040						
AR	VFD units												
Q	Average Current					0	x			VFD	DDC with Third party Integrator	* Supply, Installation, Testing & Commissioning of Modbus Integrator. * Modbus RS-485 Cable laying from Integrator to Energy Meters. * Cable Termination at Integrator End.	NA
2	Voltage					0	x						
3	Kilowatt					0	x						
4	Run hour					0	x						
5	Power Factor					0	x						
6	Forward Active Energy					0	x						
7	Power Factor Average					0	x						
8	Line to Line Voltage Average					0	x						
9	Line to Line Neutral Average					0	x						
10	Frequency					0	x						
	Total		0	0	0	0	0						
R	Diesel Generator	4											
1	DG - Lube Oil Pressure					4	x			DG controller	DDC with Third party Integrator	* Supply, Installation, Testing & Commissioning of Modbus Integrator.	NA
2	DG - Lube Oil Temperature					4	x						
3	DG - Engine Common Shutdown					4	x						

BMS													
SI.NO	PARTICULARS		I/O DETAILS				I/O Type			Connectivity		BMS Scope	HVAC Scope
4	DG - Engine Common Alarm					4	x		x			* Modbus RS-485 Cable laying from Integrator to DG Controllers. * Cable Termination at Integrator End.	
5	DG - Exhaust Temperature					4	x						
6	DG - Engine Speed					4	x						
7	DG - Engine Fail to Start					4	x						
8	DG - day tank fuel levels	4			8					Explosive Proof Level switches	DDC	* Supply, Installation, Testing and Commissioning of Level switches * Cable laying from Level switches to DDC. * Cable Termination at DDC & Field End.	NA
9	DG room Temperature		1							Temperature Sensor(S pace)	DDC	* Supply & installation of Temp Sensor. * Supply, laying & termination of cable from Temp Sensor to DDC	NA
	TOTAL		0	0	0	0	28						
S	ENERGY METER(EEM)	42											
1	Average Current					42	x			Energy Meter	DDC with Third party Integrator	* Supply, Installation, Testing & Commissioning of Modbus Integrator. * Modbus RS-485 Cable laying	NA
2	Voltage					42	x						
3	Kilowatt					42	x						
4	Run hour					42	x						
5	Power Factor					42	x						
6	Forward Active Energy					42	x						
7	Power Factor Average					42	x						

BMS													
SI.NO	PARTICULARS		I/O DETAILS				I/O Type			Connectivity		BMS Scope	HVAC Scope
8	Line to Line Voltage Average					42	x					from Integrator to Energy Meters. * Cable Termination at Integrator End.	
9	Line to Line Neutral Average					42	x						
10	Frequency					42	x						
	Total		0	0	0	0	420						
T	Elevator	32											
1	Floor Position					32	x			Lift Control Manager	DDC with Third party Integrator	* Supply, Installation, Testing & Commissioning of Modbus Integrator. * Modbus RS-485 Cable laying from Integrator to Lift Controllers. * Cable Termination at Integrator End.	NA
2	Door fully Closed Signal					32	x						
3	Status of Landing Floor (Open/Close)					32	x						
4	Inspection Status (Normal/Maintenance)					32	x						
5	Emergency Stop Status					32	x						
6	Fault Indication					32	x						
7	Fireman Switch Status					32	x						
8	Lift Auto/Manual Status					32	x						
9	Lift Run Status					32	x		x				
	Total		0	0	0	0	288						
U	UPS	6											
1	Communication Status					6	x			UPS	DDC with Third party Integrator	* Supply, Installation, Testing & Commissioning of Modbus Integrator. * Modbus RS-485 Cable laying	NA
2	I/P Voltage - RY					6	x						
3	I/P Voltage - YB					6	x						
4	I/P Voltage - BR					6	x						
5	O/P Voltage - R					6	x						
6	O/P Voltage - Y					6	x						
7	O/P Voltage - B					6	x						

BMS													
SI.NO	PARTICULARS		I/O DETAILS				I/O Type			Connectivity		BMS Scope	HVAC Scope
8	O/P Current - R					6	x					from Integrator to UPS. * Cable Termination at Integrator End.	
9	O/P Current - Y					6	x						
10	O/P Current - Y					6	x						
11	Battery Voltage					6	x						
12	Battery Charge Remaining					6	x						
13	Loading Percentage					6	x						
14	Frequency					6	x						
15	Alarm Status					6				x			
	Total		0	0	0	0	90						
v	FAS					4000							
w	SOLAR					100							
	TOTAL		780	365	1272	361	6984						
								x	x	x	future equipme nt's	DDC	
	SPARE		156	73	254	72	1397	x			future equipme nt's	DDC with third party integrat or	
	Grand total		936	438	1526	433	8381						
												Legends:	
												PFC-Potential free contact(NO/NC contact)	
												DDC-Direct Digital controller	
												LCP -Local Control Panel (electrical	

BMS														
SI.NO	PARTICULARS		I/O DETAILS					I/O Type			Connectivity		BMS Scope	HVAC Scope
													starter panel)	
													DP switch- Differential pressure switch	

2.0 CENTRAL STATIONS SOFTWARE AND HARDWARE

2.1 CENTRAL STATION SOFTWARE

- A. A central server, located at Control Room, shall be provided. The server shall support all DDC's connected to the customer's network whether local or remote.
- B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, PSTN or dial-up connection.
- C. It shall be possible to provide access to all DDC & 3rd party integration units via a single connection to the server. In this configuration, each DDC can be accessed from the Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the Local Area network.
- D. The server software shall provide the following functions, at a minimum:
- Complete control and monitoring of IBMS system from colour graphics pages on the machine, or from a remote web browser.
 - Full client-server operation.
 - SQL / JDBC / ORACLE Database.
 - Comprehensive alarm handling with alarm retransmission and logging.
 - Scheduled recording of logged data from DDC.
 - Management of multiple controller occupation times.
 - Multilevel security system.
 - International language support
 - Display of HTML pages from company Intranet, or Internet.
 - Display of live, logged, or recorded data in multi-trace graphs.
 - Simple engineering path using drag and drop operations.
 - Self-learning of all local networks.
 - Help file in PDF format for viewing or printing.
 - Access to the configuration mode of devices.
 - Display all devices on the system connected via LANs, internet works, autodialed links and Ethernet Network connections.
 - Customised program creation environment.

The BMS software shall be simple, flexible and convenient to use such that an operator with minimal programming knowledge can use it to perform control / monitoring and to build programs for control applications, graphics to generate management information systems (MIS) reports. As well, on higher end it shall be possible to create customized programs to suite the site requirement by a software programmer. All necessary documents required to make customization possible should be available along with the software without any additional charge.

The operating system shall be the Microsoft Windows 10 / Windows 8.1 / Windows 2012 R2 Server / Enterprise /Professional 64 bit multitasking environment. The networking software shall use the TCP / IP LAN protocol. The system shall be capable of supporting up to 25 simultaneous operator workstation connections but however presently we need Five User Option.

2.2 Monitoring and control functions

Monitoring:

The system shall support data acquisition using periodic scanning, exception reporting or on operator request. The system shall support a range of scan intervals, ranging from less than 5 second up to several minutes as desired / required. The system shall allow certain selected points to be scanned more often / faster than other points.

The communication techniques shall be optimized to minimize network traffic while providing good system response and reliability. The system shall also provide utilities to compile aggregate statistics on communication link usage.

Control:

Control transactions issued by the operator shall be communicated to control devices using a write followed by read to ensure the integrity of the transaction. If the read following the write to the device indicates that the control action has failed, the operator shall be informed by means of a control failure alarm. The priority of the control failure alarm shall be configurable by the user.

2.3 System Database

The system shall provide a real-time database incorporating data from analogue, logical or pulse inputs. The database shall be configurable by the end user without the need for any programming and shall be able to modify on-line without interrupting operation of the system. In addition to point based information, the database shall also provide historization capabilities for analogue, digital, pulse; event based information and calculated values. This information shall be accessible by all facilities of the system such as custom displays, reports, trends, user written application, etc.,

The real-time database shall use suitable data structures to collect and store the following categories of data, as minimum.

- ◆ Access points
- ◆ Analogue points
- ◆ Status points
- ◆ Accumulator points
- ◆ Historical data
- ◆ Event data

The facility shall also exist to accommodate user defined data structures.

Each of the point database structures shall be comprised as a composite point with a number of associated parameters that may be referenced relative to a single tag name. Specifically, each of these parameters shall be accessible by various sub-systems such as the graphical operator interface, report generation system and application program interface in a simple format without the need to know any internal storage mechanism.

The system shall maintain portions of the data base requiring frequent high-speed access as memory resident information and other less frequently accessed data as disk resident data.

Database backup shall be possible with the system on-line including backup of historical based data. The database backup shall be part of GUI software & shall be possible to configure automatic backup at regular interval without any user interference / attention. All other backup such as graphic pages / drawing etc can be windows based where simple copy & paste should be enough for taking backup other than database. Long term storage of this data shall be possible using the zip drive. The system shall have the provisions for importing this data at later date for analysis and long terms MIS reports.

Point data shall be stored in a composite point database structure that provides a wide range of configurable information including but not limited to:

- ◆ Point name and description
- ◆ Multiple locations for data storage and device scanning addresses.
- ◆ Scan period
- ◆ Multiple dead-band or hysteresis settings
- ◆ Monitoring and control access restriction information.
- ◆ Location of operator alarm handling instructions
- ◆ Location of ancillary information associated with the point.

2.4 Historical data storage

Collection of historical point data shall be configurable as part of the point definition. Once configured, this data shall be collected automatically. Historical data collection shall be provided for both snapshots and averages with intervals ranging from 5 seconds to several hours.

The system shall provide the necessary means to easily locate the particular value of interest for any of the historical points. The graphical operator interface, trend, report generation and application interfaces shall be able to access historical data.

2.5 Trending

The system shall provide flexible trending allowing real-time, historical or achieved data to be trended in a variety of formats. In addition, trend data types shall be able to combine to allow for comparisons between data e.g. current real-time data versus archived data. The system shall provide trending capability with following functions.

- ◆ Real time trending
- ◆ Historical trending
- ◆ Archived history trending
- ◆ Trend scrolling
- ◆ Trend zoom
- ◆ Export option / Copying of currently displayed trend data to the clipboard for pasting into spreadsheet or document.

The system shall allow the trending of a minimum of 5 points in a single trend display set. For each trend set display it shall be possible for operators to configure the number of historical samples and ranges displayed. Points configured in trend sets shall be changeable on-line.

Operators shall be able to zoom in on information displayed on trend sets for closer inspection by dragging out an area of interest with the mouse or other pointing devices. From such a selection, it shall be possible to copy the underlying data to the windows clipboard for subsequent pasting into spreadsheet application such as Microsoft excel

2.6 Alarm Management

The software shall include a well organized alarm management facility to enable the operator to react quickly and efficiently to alarm conditions. Apart from the specific points identified for alarm annunciation in the I/O points schedule, the alarm types supported shall included:

- ◆ Very high value alarm
- ◆ Very low value alarm
- ◆ Large deviation alarm
- ◆ Rate of change alarm
- ◆ Unreasonable value alarm
- ◆ Delay to avoid nuisance alarm / short time change in value

The system shall permit any of these alarm types to be applied to the analog and accumulated points.

- ◆ The software shall permit at least 90 levels of alarm priorities to be assigned to each alarm ranging from the lowest to the highest. These levels shall be easily distinguished by the manner in which they are presented such as the color of the alarm message, blinking of the alarm message, varying audible alarms, etc., All alarm shall be logged in the event / alarm file and / or on the alarm printer. On acknowledgement of an alarm, it shall be possible to automatically issue a reset command to the controller so as to attempt to reset the alarm point.

2.7 Reporting

The system shall support a flexible reporting package to allow easy generation of report data.

The reports provided shall include pre-configured standard reports for common requirements such as alarm / event reports and custom report generation facilities that are configurable by the user.

The following pre-formatted reports shall be available on the system:

- ◆ Alarm / event report
- ◆ Operator trail report
- ◆ Point trail report
- ◆ Alarm duration report
- ◆ All point report
- ◆ Point attribute report
- ◆ Lockout summary
- ◆ Over-ride summary

Configuration of these reports shall only require entry of the schedule information, and other parameters such as point name or wildcard, filter information, time interval for search and destination printer to fully configure the report. No programming shall be required.

The requirement of the above mentioned reports shall be as follows:

Alarm/Event Report

This report shall be summary of all events of a specified type for nominated points occurring in a time period. The time period may be specified as an absolute start and end date and time, or as a period to the current time.

Operator trail report

This report shall be a summary of all operator actions relating to a specific operator in a specified period.

Point trail report

This report shall be provided to produce a summary of all events of a specified type occurring in a period on nominated points.

Alarm duration report

This report shall be provided to calculate the total amount of time a nominated point or group of points has been in an alarm condition over a given time period.

All point report

A report shall be provided to produce a list of point information, including point name, description, point type, engineering units, and current values.

Point attributes report

A report shall be provided for summaries of the points selected as per the following criteria:

- ◆ Out of service
- ◆ Alarm suppressed
- ◆ Abnormal input levels
- ◆ In manual mode.

Over-ride summary

This report shall be used to provide the summary of all points / commands that have been over-riden by the operator.

2.8 Time Schedules:

The system shall include the facility for time scheduling activities on both a periodic and one-off basis. All time schedules shall be configurable via the Operator workstation. Each time schedule entry shall consist of:

- ◆ Date
- ◆ Time
- ◆ Point name

- ◆ Point Parameter
- ◆ Target Value
- ◆ Type of scheduling

- ◆ The available time schedule type shall include:
 - Daily – to be executed everyday
 - Workday – to be executed on the week days
 - Holidays – to be executed on holidays
 - Individual days – to be executed on a particular day

The system shall also have the provision for programming temporary schedules that over-ride the normal schedule.

2.9 Energy Monitoring & Analysis:

Energy Monitoring & Analysis should be integral part of GUI. It shall support minimum of 50 Energy points for analysis purpose. The software shall provide the following feature but are not limited to,

- a) It shall be possible to generate & view detailed Daily, Weekly & monthly graphs of the energy meter / point identified.
- b) It shall be possible to see and analyze the total energy usage in a building and also shall be possible to identify by which system is major user of the energy.
- c) It shall be possible to compare the energy points week against week, day against day in a month, identify Maximum, Minimum & average daily values & Energy usage for different periods of time of the day.
- d) It shall be possible to make cost and consumption analysis or CO2 reports on consumption.
- e) Based on the energy consumed it shall be possible to rank the systems or building (in case of multi location buildings)
- f) Software shall allow the user to compare the predicted / forecasted energy or based on historic performance with current performance.
- g) It shall be possible to create energy signature with respect to ambient / outside temperature of the day
- h) Software shall allow the user to identify the exceptions happened in the system due to which energy consumption was increased.
- i) It shall be possible to compare the energy consumption after introducing a energy saving strategy for further fine tuning or to visualize the savings achieved.

2.10 Operator Interface:

The operator interface provided by the system shall through an intuitive graphical user interface and shall allow for efficient communication of operational data and abnormal conditions. It shall provide a consistent frame work for viewing of information. Critical areas (such as alarm icons) shall be visible all the times. A predefined area on the screen shall provide operator messaging, and this area shall also be visible at all times.

The operator interface shall be interactive and based on graphics and / or icons. Standard tool bar icons and drop-down menus shall be available on all standard and custom display to allow easy access to common functions.

The system shall provide an operator interface with the following minimum capabilities:

- ◆ Window re-size, zoom in, zoom out.
- ◆ Dedicated icons and pull down menus to perform the following:
- ◆ Associated display
- ◆ Alarm summary
- ◆ Alarm acknowledgement
- ◆ Previous display recall
- ◆ Graphic call-up
- ◆ Trend call-up
- ◆ Point detail
- ◆ Current security level
- ◆ Alarm annunciation
- ◆ Communication fail annunciation
- ◆ Operator message zone.

2.11 Area assignment / area profile

Each operator shall be assigned one or more specific areas / functions of the facility with the appropriate monitoring and control responsibility. An area shall be defined in this context as a logical entity comprising of a set of points in the system. This in turn may represent a physical space in the facility or a particular utility or a particular equipment.

The system shall provide the facility to create area profiles, which combine areas and time periods, and which can be assigned to operators with the same area access requirements. By using area profiles in this way, area access can be specified to apply during certain time periods, allowing different areas of access at different times of the day or week.

2.12 Command partitioning

It shall be possible to assign to each operator a set of allowed commands / operating for each assigned area. With this feature, it shall for example be possible to configure an operator to set a digital point to On, but to disallow the same operator from setting the same digital point to OFF.

2.13 Standard system displays

The following displays shall be included as part of the system:

- ◆ Alarm summary display
- ◆ Event summary display
- ◆ Point detail template displays
- ◆ Trend set template displays
- ◆ Communication status displays
- ◆ System status displays
- ◆ Operator scratch-pad display.

2.14 System Status Displays

These shall display the following information

- ◆ Points in alarm condition pending acknowledgement
- ◆ Points which remain in an alarm condition state but which have been acknowledged.
- ◆ Communication failure
- ◆ Printer Status
- ◆ Operator workstation status
- ◆ Controller status

2.15 Administrative Displays

The system shall provide the following full screen display

- ◆ Master system menu
- ◆ Report summary
- ◆ Alarm summary
- ◆ Event summary
- ◆ Display summary.
- ◆ Area assignment
- ◆ Holiday assignment
- ◆ History assignment
- ◆ Push-button assignment
- ◆ Operator definition
- ◆ Operator message board
- ◆ Events archive and retrieval
- ◆ Time period summary

2.16 Other requirements

It shall be possible to launch any windows based applications, such as Microsoft word or Microsoft excel, from within the operator interface.

2.17 Help Facility

Software shall be provided to facilitate programming and storage of the system operation manuals in the hard-disk. The operation manual shall be retrieved by On Line Help mode so as to enable the operator to self learn the system operation, command, or function as and when needed.

This 'help' facility shall be made available to the operator by use of a dedicated key or a single key click on the mouse. A minimum help shall be available for every menu item and dialogue box.

The facility shall contain both text and graphics to provide information about the selected function directly.

The information provided shall be in simple clear language and shall be possible to search the help based on typical word included in the process.

When a point is overridden by operator command from an operator workstation or a local workstation, an alarm message shall be output to the appropriate alarm printer and to respective operator workstation. Alarm messages shall require operator acknowledgement.

When a point returns to normal, the event shall be recorded in control stations as 'Return to Normal'.

The Operator workstations shall be capable of displaying a list of all points in alarm for the building in a single summary. Systems which require the operator to make a separate summary for alarms shall not be acceptable. The software shall also provide details of particular alarm occurred on a point.

3.0 3rd Party System Integrator Units:

- A. The 3rd party Integration unit shall provide the interface between Ethernet LAN and the 3rd party field control devices such as DDC or PLC or any other devices which need to be integrated. These shall also provide supervisory capability of functions over the devices connected to it. **The purpose of using these units should be limited to integrate devices only, not for any DDC interface with GUI, provided by others.**
- B. The Unit must provide the following hardware features as a minimum:

- a. Two no. on board Ethernet port
 - b. Two No. on Board RS-485 port
 - c. Provision to include / add additional communication card
 - d. Twenty-Five analytics points license by default
 - e. 4GB memory
- C. The Unit must communicate over TCP/IP with communication speed of 10/100MBPS.
- D. The Integration unit shall have built in drivers for open protocol such as
- a. Bacnet over MSTP
 - b. Bacnet over IP
 - c. Modbus over MSTP
 - d. Modbus over IP
 - e. Lon FTT
 - f. Lon IP
 - g. Mbus over TCP
 - h. Mbus Serial
 - i. SNMP

If the above drivers are add-on products, it shall be made available / considered while selecting the unit & the same to be confirmed in writing.

- E. The Integration unit shall provide flexibility of adding communication ports (RS485) by adding communication cards, minimum one slot, when required rather than adding additional unit itself.
- F. The Integration unit shall have inbuilt JAVA engine and it shall be possible to configure the IO, if required, of the 3rd party devices.
- G. The Integration unit should be capable of handling multiple protocol simultaneously and should not be restricted to single protocol.
- H. The Integration unit should have inbuilt memory for program storage.
- I. The Integration unit should automatically backup its database for the user defined interval.
- j. User authentication should be integral part of the unit.
- K. All vendors are required to provide the documentation highlighting the capabilities mentioned above.
- L. All units shall have LEDs for fault / status identification such as
- a. LAN active (one per port in case of multiport units)
 - b. LED to display proper functionality / Status of the unit.
 - c. LED to display healthiness of CPU of the unit.

4.0 DIRECT DIGITAL CONTROLLER

4.1 DIRECT DIGITAL CONTROLLER (DDC) HARDWARE REQUIREMENT :

- 1) DDC controllers shall be capable of fully "stand- alone" operation i.e. In the event of loss of communication with other DDC's or Control Station, they shall be able to function on their own.
- 2) The controllers shall consist of **dual 32 bit microprocessors for reliable throughput**, with EEPROM based operating system on BACNET
- 3) The memory available to the controller board should serve as working space and there should not be any limitation of using particular function block other than the memory.
- 4) The controllers shall be UL listed and conforming to CE.
- 5) The controller shall have support programs built in RAM for minimum of 120 hours in the event of a power failure and it shall be possible to fit any battery thus expanding the time limit to 5 years. An alarm shall be generated on low battery voltage. The battery shall not be required to supply power to actuators, valves, dampers etc.
- 6) DDC shall have embedded **TCP/IP connectivity** so that it can be hooked into the Local Area Network (LAN) provided by the client / can be on dedicated network created by the vendor. Each DDC can be accessed from the **Graphical User Interface (GUI)** or from a standard Web browser (WBI) by connecting to the server.
- 7) Controller shall have capability to communicate with other controllers for any interlock or data sharing using peer to peer technology. The Controller which route the messages or data sharing through the system or any intermediate hard ware / controller shall not be acceptable.

Vendor to demonstrate this capability during the commissioning time and the same shall be verified at the time of handing over.

- 8) Each controller shall have RS232 port built on to it so that any trouble shooting required at field level can be carried out without removing the controller from the network (LAN).
- 9) All controllers shall accept **230V, 50Hz** Uninterrupted power supply, provided by end user, directly so that the in between hardware such as transformers and SMPS are avoided.
- 10) Controller shall support DHCP addressing over Local Area Network (LAN) so that the static IP requirements are reduced however a single static IP shall be provided for system so that it can be hosted on to internet in consultation with end user / consultant.
- 11) All controllers shall have capability to provide 24V DC auxiliary power supply for the sensor which requires power, however the same shall not be required to high power consuming devices / equipments such as actuators, dampers etc.

Vendors to provide details on the same at the time of offer.

- 12) The Controllers shall have proportional control, Proportional + Integral (PI) Control, Proportional plus Integral plus Derivative (PID) Control, Two Position Control and Time Proportioning Control and algorithms etc, all in its memory and all available for use by the user, i.e. all the control modes shall be software selectable at any time and in any combination. The analog output of Proportional Control, PI Control, and PID Control shall continuously be updated and output by the program shall be provided. Between cycles the analog output shall retain its last value. Enhanced integral action in lieu of Derivative function shall not be acceptable.
Automatic loop tuning facility should be available to tune the loop at regular interval and adjust the gain or the integral / derivative time.
- 13) The controllers shall have a resident real time clock for providing time of day, day of week, date, month and year. These shall be capable of being synchronized with system / time master clocks in the network.

Upon power restoration all clocks shall be automatically synchronized to the time master controller which will be set during the commissioning phase.

- 14) The microprocessor based DDC's shall be provided with power supply, A/D and D/A converters, memory and capacity to accommodate a maximum of 192 input/output (I/O) hardware points (with or without an expansion board).
- 15) If the controllers provided by the contractor have the configurable plug in function cards, then the following minimum specifications shall have to be met :
 - i) The cards shall provide for analog or digital, input or output, hardwired connections to the installed plant.
 - ii) The quantity and combination of these cards shall be determined by the requirements of the plant in that location with the concurrence of the Owner/ Consultant.
- 16) The DDC's shall have 15% spare capacity for each type of point (digital/analog input/output) to give flexibility for future expansion.
- 17) All DDC controllers shall have 10 / 12 bit A/D resolution and be capable of handling voltage, milli-ampere, resistance or open and closed contacts inputs in any mix, if required.

Analog inputs/outputs of the following minimum types shall be supported:

- a. 4-20 mA.
- b. 0-10 volts.
- c. 2-10 volts.
- d. Resistance Signals (either PTC or NTC such as PT 100, PT 1000, PT 3000, NTC20K)

Digital input/output types to be supported shall be, but not limited to the following:

- i) Normally-open contacts.
- ii) Normally-closed contacts.
- iii) Pulse inputs

Modulating outputs shall be true proportional outputs and not floating control type.

- 18) It shall be possible to change the analog inputs to accept any of the above depending upon the site condition or system requirement using a jumper. **The DDC which is configured using software trigger / switch shall not be acceptable.**
- 19) Controller's packaging shall be such that, complete installation and check out of field wiring can be done prior to the installation of electronic boards.
- 20) All board terminations shall be made via plug-in connectors to facilitate trouble-shooting, repair and replacement. Soldering of connections shall not be permitted.
- 21) Controllers shall preferably be equipped with diagnostic LED indicators with at least indication for Power up Test OK, Watch dog and Bus Error. All LED's shall be visible without opening the DDC cover.
- 22) It shall be possible for the controllers to accept regulated uninterrupted power supply to maintain full operation of the controller functions (control, logging, monitoring and communications) in the event of a localized mains failure.
- 23) Controllers requiring fan cooling are not acceptable.
- 24) There shall be the facility for accessing controller data information locally, via a portable plug-in color LCD display which will be common to all controllers and normally removed to prevent unauthorized tampering. In either case, access to the system thus provided shall be restricted by passwords in the same way as at the main operator terminal.
- 25) In case the Portable operator Terminals (POT) are required to programmed the controllers, sockets shall be provided for same. Attachment of POT shall not interrupt or disable normal panel operation or bus connection in any way.

- 26) The controllers shall be housed in vandal proof boxes to protect them from tampering by any unauthorized personnel. All DDC controllers used in plant room spaces and external application shall be housed IP66/IP54 rating enclosures.
- 27) It shall be possible to add new controllers to the system without taking any part of the system off-line.
- 28) All DDC should have XML web service option which can be enabled in later stage for any higher interface with IT infrastructure or any other service.
- 29) Individual DDC should be BTL (Bacnet Testing Lab) tested.

4.2 DIRECT DIGITAL CONTROLLERS CAPABILITIES :

1) The Controllers shall have a self analysis feature and shall transmit any malfunction messages to the Control Station. For any failed chip the diagnostic tests, printout shall include identification of each and every chip on the board with the chip number/location and whether the chip "Passed" or "Failed" the diagnostic test. This is a desired requirement as it would facilitate trouble-shooting and ensure the shortest possible down time of any failed controller. Controllers without such safety feature shall be provided with custom software diagnostic resident in the EEPROM. The tenderer shall confirm in writing that all controllers are provided with this diagnostic requirement.

2) Operating system (O.S.) software for controllers shall be EPROM resident.

Controllers shall have resident in its memory and available to the programs, a relevant library of algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences.

3) In the event of failure of communication between the controllers and/or Control Station terminal, alarms, reports and logs shall be stored at the controllers and transmitted to the terminal on restoration of communication.

4) In the event of memory loss of a Controller or the expiration of back-up power, on start-up of the unit the necessary data-base shall be downloaded manually so that the logic built are verified by the user. However, controllers requiring a manual intervention for the re-boot of software are not desired.

5) Where information is required to be transmitted between controllers for the sharing of data such as outside air temperature, it shall be possible for global points to be allocated such that information may be transmitted either on change of incremental value or at specific time intervals.

6) Controllers must be able to perform the following energy management functions as a minimum,

- a. Time & Event programs
- b. Holiday Scheduling
- c. Maximum and Distributed power demand
- d. Optimum start and stop program
- e. Night purge
- f. Load reset
- g. Zero energy band
- h. Duty cycle
- i. Enthalpy analysis and control
- j. Run Time Totalization
- k. Sequencing and Optimization
- l. Exception scheduling

Detailed description of software features and operating sequence of all available energy management software shall be submitted with the tender for evaluation by the consultant.

7) The DDC Controllers shall have Adaptive Control capability whereby the control software measures response time and adjusts control parameters accordingly to provide optimum control. The software shall allow self-tuning of the variable control loops (all or any of P, P+I, P+I+D) of the AHU's and chiller system so as to provide the most efficient and optimized controls at different load conditions. The energy management programs shall update their parameters based on past experience & current operating conditions.

8) Alarm Lockout shall be provided to prevent nuisance alarms. On the initial start up of air handler and other mechanical equipment a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating an alarm comparison logic. Tenderers shall indicate their proposed system alarm handling capability & features.

9) Run time shall be accumulated based on the status of a digital input point. It shall be possible to total either ON time or OFF time. Run time counts shall be resident in non-volatile memory.

10) It shall be possible to accommodate Holiday and other planned exceptions to the normal time programs. Exception schedules shall be operator programmable up to one year in advance.

- 11) All DDC shall have trend / log storing capacity in built into it. It shall be possible to have stored the data for at least 40 days @ 1 hour sampling time for all the points of the DDC (used or unused).
- 12) Minimum communication should be 10MBPS for each of the controller.
- 13) DDC should be forward compatible type so that any expansion or upgrade of the system required in the future is easily taken care off without scrapping / removing / disturbing the existing working system.
- 14) DDC Should allow user to include graphics, if required, however it shall be of static in nature.
- 15) All DDC Should be capable of sending email to specific user in the event of alarm, identified by end user / consultants.

5.0 PORTABLE OPERATORS TERMINAL (POT)

- 1) POT shall be provided to allow operator readout of system variables, override control and adjustment of control parameters. The POT shall be portable and plug directly into individual controllers for power and data.
- 2) The minimum functionality of POT shall include :
 - Set points to a fixed value or state.
 - Display diagnostic results.
 - Display sequentially all point summary and sequentially alarm summary.
 - Display/change digital point state, analog point value.
 - Display/change time and date.
 - Display/change analog limits.
 - Display/change time schedule.
 - Display/change run time counts and run time limits.
 - Display/change time and/or event initiation.
 - Display/change programmable offset values.
 - Access DDC initialization routines and diagnostics.
 - Enable/disable points, initiators and programs.
 - Display/change minimum ON/OFF and maximum OFF times.
- 3) The POT shall be complete with command keys, data entry keys, cursor control keys **or** liquid crystal display (LCD). Access shall be via self prompting menu selection with arrow key control of next menu/previous menu and step forward/backward within a given menu.
- 4) Connection of a POT to a controller shall not interrupt or interfere with normal network operation in any way, prevent alarms from being transmitted, or interfere with Control Station commands and system modifications.
- 5) Connection of POT at any controller shall provide display access to all controllers on that bus. In case the controller has a fixed LCD display and entry keyboard, then the display access shall be available on each screen.
- 6) It should be possible to override the commands given through POT by the Operator Control Station.
- 7) POT shall have touch screen color display and it shall possible to hook this to Local area Network so that the entire system data can be visualized.
- 8) POT shall have self learning capability so that it can recognize the DDCs on the network and update all points without any manual programming.

6.0 DATA COMMUNICATION

The communication between controllers shall be via a dedicated or customer provided Ethernet communication network as per standards. Controller's microprocessor failures shall not cause loss of communication of the remainder of any network. All networks shall support global application programs, without the presence of a host PC.

Each controller shall have equal rights for data transfer. There shall be no separate device designated as the communication's master. Those systems using dependent controllers shall be pointed out by the contractor and a dual Hot redundant transmission media with automatic switching and reporting in the event of line faults will have to be provided.

The communication network shall be such that:

- 1) Every DDC must be capable of communicating with all DDC's on its own.
- 2) Network connected devices shall be capable of sending message after successive retries shall constitute a communication or device failure.

- 3) Each controller is to be provided with a communication watchdog to assure that the failure is reported to central station.
- 4) Error recovery and communication initialization routines are to be resident in each network connected device.
- 5) The communication protocol shall incorporate CRC (Cyclic Redundancy Check) to detect transmission errors.

Single or multiple standalone controller failures shall not cause loss of communication between active DDCs connected on the communication network. Full communication shall be sustained as long as there are at least two operational stand alone control panels active on the communication network.

All the System Integration Units shall be linked together on a Local Area Network.

The communication network shall include provision for automatically reconfiguring itself to allow all operational equipment to perform as efficiently as possible in the event of single or multiple failures.

The BAS supplier shall be required to provide details of standards to which their system conforms.

7.0 FIELD DEVICES

7.1 ELECTRIC AND ELECTRONIC CONTROLS RELATED EQUIPMENT

General Requirements

All controls shall be capable of operating in ambient conditions varying between 0-55 deg. C and 90% R.H. non-condensing.

All Control devices shall have a 20 mm conduit knockout. Alternatively, they shall be supplied with adaptors for 20 mm conduit.

Ancillary Items

When items of equipment are installed in the situations listed below, the BAS contractor shall include the following ancillary items:

(i) Weather Protection

All devices required to be weatherproofed are detailed in the Schedule of Quantities. IP ratings for the equipment are mentioned in the respective section.

(ii) Pipework Immersion

Corrosion resisting pockets of a length suitable for the complete active length of the device, screwed 1/2" (13 mm) or 3/4" (20 mm) NPT suitable for the temperature, pressure and medium.

(iii) Duct Mounting (Metal or Builders Work)

Mounting flanges, clamping bushes, couplings, locknuts, gaskets, brackets, sealing glands and any special fittings necessitated by the device.

7.2 TEMPERATURE SENSOR

Temperature sensors for space, pipes and ducts, shall be of the Resistance Temperature detector (RTD) type or thermistor. These shall be two wire type and shall conform to the following specifications :

- 1) Immersion sensors shall be high accuracy type with a high resistance versus temperature change. The accuracy shall be at least ± 1.33 deg C.
- 2) Immersion sensors shall be provided with separate Brass thermo well. These shall be manufactured from bar stock with hydrostatic pressure rating of at least 10 kgf/cm².
- 3) The connection to the pipe shall be screwed type. An aluminum sleeve shall be provided to ensure proper heat transfer from the well to the sensor. Terminations to be provided on the head. Flying leads shall not be acceptable.
- 4) The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections.
- 5) Duct temperature sensors shall be with rigid stem and of averaging type. These shall be suitable for duct installation.
- 6) Outdoor air temperature sensor shall be provided with a sun shield.
- 7) The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

The temperature sensors may be of any of the following types :

- 1) PT 100, PT 1000, PT 3000
- 2) Thermistor

7.3 HUMIDITY SENSOR

Space and duct humidity sensors shall be of capacitance type with an effective sensing range of 10% to 90% RH. Accuracy shall be + 3% or better. Duct mounted humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with a housing. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

7.4 FLOW METER

Water flow meters shall be either Electro magnetic or ultra sonic type. For electromagnetic flow meter, teflon lining with 316 SS electrodes must be provided. The housing shall have IP 55 protection. Vendors shall have to get their design/ selection approved by the Consultant, prior to the supply.

The exact ranges to be set shall be determined by the contractor at the time of commissioning. It should be possible to 'zero' the flow meter without any external instruments, with the overall accuracy of at least $\pm 1\%$ full scale.

7.5 PRESSURE TRANSMITTER FOR WATER

Pressure transmitters shall be piezo-electric type or diaphragm type. (Bourdon Tube type shall not be acceptable). Output shall be 4-20mA or 0-10V DC and the range as specified in the data sheet depending on the line pressure. Power supply shall be either 24 V AC, 24 V DC or 230 V AC. Connection shall be as per manufacturer's standards. The pressure detector shall be capable of withstanding a hydraulic test pressure of twice the working pressure. The set point shall fall within 40%-70% of the sensing range and detector shall have sensitivity such that change of 1.5% from the stabilized condition shall cause modulation of the corrective element. The sensor must be pressure compensated for a medium temperature of -10°C to 60°C with ambient ranging between 0°C to 55°C .

7.6 DIFFERENTIAL PRESSURE SWITCH FOR PIPE WORK

These shall be used to measure pressure differential across suction and discharge of pumps. The range shall be as specified in the data sheet. Switch shall be ON with increase in differential. Housing for these shall be weather proof with IP 55 protection. The pressure switch shall be capable of withstanding a hydraulic test pressure of 1.5 times the working pressure. The set point shall fall in 40-70% of the scale range and shall have differentials adjustable over 10%-30% of the scale range. The switches shall be provided with site adjustable scale and with 1 NO/NC contacts.

7.7 DIFFERENTIAL PRESSURE SWITCH FOR AIR SYSTEMS

These shall be diaphragm operated. Switches shall be supplied with air connections permitting their use as static or differential pressure switches.

The switch shall be of differential pressure type complete with connecting tube and metal bends for connections to the duct. The housing shall be IP 54 rated. The pressure switches shall be available in minimum of 3 ranges suitable for applications like Air flow proving, dirty filter, etc. The set point shall be concealed type. The contact shall be SPDT type with 230 VAC, 1A rating.

The switch shall be supplied suitable for wall mounting on ducts. It should be mounted in such a way that the condensation flow out of the sensing tips. Proper adaptor shall be provided for the cables.

The set point shall fall within 40%-70% of the scale range and I has differentials adjustable over 10%-30% of the scale range. The switches shall be provided with site adjustable scale and with 1 NO/NC contacts.

7.8 AIR FLOW SWITCHES

Air flow switches shall be selected for the correct air velocity, duct size and mounting attitude. If any special atmospheric conditions are detailed in the Schedule of Quantity the parts of the

switches shall be suitably coated or made to withstand such conditions. These shall be suitable for mounting in any plane. Output shall be 1 NO/NC potential free. Site adjustable scale shall also be provided.

7.9 AIR PRESSURE SENSOR

The pressure sensor shall be differential type. The construction shall be spring loaded diaphragm type. The movement of the membrane in relation to the pressure should be converted by an inductive electromagnet coupling which would give an output suitable for the controller. The pressure sensor shall be in a housing having IP 54 ratings in accordance with IEC 529. Suitable mounting arrangement shall be available on the sensor. The sensor shall come complete with the PVC tubes & probes.

7.10 WATER FLOW SWITCH

These shall be paddle type and suitable for the type of liquid flowing in the line. Output shall be 1NO/1NC potential free.

7.11 CO SENSOR

CO Sensor shall be integrated Surface mounted type on the field. These shall work on 24V AC/DC supply with the output being standard type i.e. 4-20 mA / 0- 10 Volts etc. Response time of the detector shall be <10 minutes

7.12 AIR VELOCITY SENSOR

Air Velocity Sensor shall be integrated Surface / Duct mounted type on the field. These shall work on 24V AC/DC supply with +/- 10% variation the output being standard type i.e. 4-20 mA / 0- 10 Volts etc with an accuracy of +/- 3%. It shall be possible to select the different ranges by changing the jumpers on the sensor. At least 3 selection ranges on the sensors are required.

7.13 CO2 SENSOR – Space Type

CO2 Sensor shall be wall / Surface mounted type on the field. These shall work on 24V AC/DC supply with the output being standard type i.e. 4-20 mA / 0- 10 Volts etc. The sensing range required shall be 0-2000 PPM with good resolution.

The preferred type of sensing element / method is NDIR type with accuracy of +/-30PPM or +/- 5% of measured value. Warm up time of sensor shall be <2 minutes & response time is better than 150 seconds. Sensor shall be suitable to fix & operate at 1500 to 1750mm above the finished floor level.

7.14 LEVEL SWITCH

The level switches shall have to meet the following requirement:

Type	:	Float Type/Capacitance type/Conductivity type
Mounting	:	To suit application.
Connection	:	Flanged ANSI 150 lbs RF Carbon steel
Float material	:	316 SS
Stem Material	:	316 SS
Output	:	1 NO, 1 NC potential free
Switch Enclosure	:	IP 55

8.0 ENCLOSURES FOR CONTROLLERS AND ELECTRICAL PANELS

All the controllers shall be housed in Lockable Vandal proof boxes which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for tropical climatic conditions.

The panel shall be metal enclosed 18 SWG CRCA sheet steel cubicle with gaskets between all adjacent units and beneath all covers to render the joints dust proof. All doors and covers shall be hinged and latched and shall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag grounded off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and secured with the frame and holes in the panels correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with nuts. Self threading screws shall not be used in the construction of control panels. Knockout holes of approved size and number shall be provided in the panels in conformity with the location of incoming and outgoing conduits/cables. Lamps shall be provided to support the weight of the cables. The dimension of the boxes shall depend on the requirement with the colour decided in consultation with the Architect/Consultant.

Note: All panel enclosures used in plant room spaces and external to building shall be suitable for outdoor application (IP 54 protection).

9.0 CONDUITS AND WIRING

Prior to laying and fixing of conduits, the contractor shall carefully examine the drawings indicating the layout, satisfy himself about the sufficiency of number and sizes of conduits, sizes and location of conduits and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of Architect/Engineers any modifications suggested by the Contractor shall be got approved by the Architect /Engineers before the actual laying of conduits is commenced.

9.1 CONDUITS/TRUNKER

Conduits and accessories shall conform to relevant Indian Standards. PVC conduits of required dia shall be used as called for in the schedule of quantities. Joints between conduits and accessories shall be securely made, with help of adhesive.

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

9.2 CONNECTIONS

All jointing methods shall be subject to the approval of the Architect/Engineer. Separate conduits shall run for all power wiring.

The threads and sockets shall be free from grease and oil. Connections between conduit and controller metal boxes shall be by means of brass hexagon smooth bore bush, fixed inside the box and connected through a coupler to the conduit. The joints in conduits shall be smooth to avoid damage to insulation of conductors while pulling them through the conduits.

9.3 BENDS IN CONDUIT

Where necessary, bends or diversions may be achieved by means of bends and/or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with a finished wall surface. No bends shall have radius less than 2-1/2 times the outside diameter of the conduit.

9.4 FIXING CONDUITS

The conduits, junction boxes, outlet boxes and controller boxes once installed in position, shall have their outlets properly plugged or covered so that water, mortar, insects or any other foreign matter does not enter into the conduit system. Surface conduits shall be fixed by means of spacer bar saddles at intervals not more than 500 mm.

The saddles shall be 2 mm x 19 mm galvanized steel flat, properly treated, primer coated & painted, securely fixed to supports by means of nuts and bolts/rawl bolts and brass machines screws.

9.5 DRAWING OF CONDUCTORS

While drawing insulated wires/cable into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. No joint shall be allowed in case of breakage of any conductor. No joint shall be shaved off like length of the conductors. Insulation shall be shaved off like sharpening of a pencil and it shall not be removed by cutting it square to avoid depression/cutting of conducting material.

Strands of wires shall not be cut to accommodate & connect to the terminals. Terminals shall have sufficient cross-sectional area to take all the strands.

No wire shall be drawn into any conduit until all work of any nature that may cause injury to wire is completed. Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction. Where wires are connected to detectors, or panel, sufficient extra length of wires shall be provided to facilitate easy connections and maintenance.

Only licensed supervisors/wiremen shall be employed for cabling and other connected work. Only approved make of cables shall be used. The cables shall be brought to the site in original packing.

9.6 **MODE OF MEASUREMENT**

Signal Cable

The cabling running between DDC controllers to the field devices shall be termed as signal cabling. This cabling along with conduits shall be payable on per I/O point basis.

LAN Cable

The cable connecting various system integration units to the control station shall be termed as LAN cable. These cable alongwith conduits shall be measurable on unit length basis.

10.0 SIGNAL CABLING & COMMUNICATION CABLING

The signal cable shall be of the following specifications:

- | | | |
|------------------------------------|---|--|
| a. Wire | : | Annealed Tinned Copper |
| b. Size | : | 1.0 sq. mm, stranded type |
| c. No. of conductors | : | Two (One pair) |
| d. Shielding | : | Overall beld foil Aluminium polyester shield. |
| e. Jacket | : | Chrome PVC |
| f. Nominal DCR | : | 17.6 ohm/km for conductor
57.0 ohm/km for shield |
| g. Nominal capacitance
at 1 KHz | : | 130 pF/m between conductors
180 pF/m between one conductor and other
Conductors connected to shield. |

11.0 LOCAL AREA NETWORK CABLE

Depending on the type of LAN system being used by the contractor, standard, manufacturer's specification shall apply.

12.0 BMS DELIVERABLES-

The deliverables expected from the BMS in broadly defined here under. However it is understood that the I / O summary detailed in this specifications will be reckoned while designing the system.

Ventilation:

1. Timed scheduled operation ventilation fans.
2. Facility to bring into any of the additional fans into operation in the event of maintenance on any of the main in-line fans.
3. Status of fans
4. Status of Generator room, STP room, and toilet ventilation fans
5. Status of staircase pressurization and kitchen exhaust fans
6. Run Time Reports for above equipment
7. Trending of CO concentration levels.

Chillers:

The chiller supplier shall provide software interface by providing linking of all Chiller Microprocessor panel for communication between panels. Additionally, he shall provide single point gateway for high level integration with read/write capability to the BMS system.

1. Data logging of Chillers – operating parameters.
2. Fault history.
3. Cycle operation of Chillers on standby mode whenever applicable during night charge cycle.
4. Chiller sequencing and load sharing.
5. Status.
6. Customized Trends/Schedules etc. pertaining to various Chiller parameters
7. Maintenance Alarm Pop up

Pumps:

Primary and secondary Brine pumps:

1. Control and Status
2. Time totalizing- led/lag for standby operation.
3. Data logging
4. Pump status
5. Run Time of the pumps

Secondary Chilled water pumps with VFD:

1. Loading history
2. Pump Status
3. Run Time of the pumps

Air handling units (Standard AHU's)

1. Space Temperature Set point control
2. Actual space / RA Temperature
3. Filter status
4. Fan status
5. Auto/Manual operation status
6. Fan on/off status
7. Control valve status
8. Run Time for the Fan/Motors
9. PID Control for Valves

Air handling units (AHU's with return air fans, if applicable):

1. Emergency smoke evacuation:
2. Fans and damper control on actuation of smoke sensor.
3. Night purge / Free cooling:
4. Fans, Dampers and control valve control on ambient temperature sensing.
5. Balance deliverables as under iii. Above

6. PID Control for Valves
7. Run Time for Fan/Motors
8. Customized Control Strategy & Switching Logic

Plumbing system:

1. Monitoring of water levels in under ground tanks and overhead tanks
2. Pumps run hours
3. Pump on-off status
4. Run Time

STP:

1. Run hours pumps in the system
2. High water level alarm

Electrical monitoring and data logging:

Parameters relevant to Automatic Transfer Switches (ATS) at the origin of utility supply and standby sources and Multi Data Meters (MDM) in outgoing feeders as per following.

(Through integration as all MDMs shall be provided with communication ports)

Data Points to be monitored & trended for MDMs: kW, kWh, kV Ar.p.f, V, A, Power outages, DG run

Data Points to be monitored & trended for KWH Meters: kW, kWh

SCHEDULE OF ITEMS

SCHEDULE OF ITEMS

High Side & Service Buildings

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
A	EQUIPMENT
1	WATER COOLED CENTRIFUGAL CHILLER (VFD DRIVE & AHF):
1.1	Supplying, Installing, testing & Commissioning of AHRI Certified centrifugal water chilling machine each having a capacity of 1436400 K.CAL/hour(475 TR)at at chilled water inlet/ outlet temperature of 56 Deg. F (13.33 Deg. C) / 44 Deg. F (6.67 Deg. C) with chilled water circulation rate of 950 USGPM (nominal) and condenser water inlet/ outlet temperature of 90.1 Deg. F (32.27 Deg. C)/ 100.1 Deg. F (37.83 Deg. C) with circulation rate 1425 USGPM (nominal), suitable for operation on refrigerant R-134A/R-1233ZD (e) each comprising of the following complete as per specification and as reqd. The scope of work shall include Lifting, shifting & positioning of chiller at location shown on drawing. Chiller shall be capable to unload from 100% to 20% even at constant ECWT of 92 degree Fahrenheit, without surging and without hot gas bypass. Maximum noise sound pressure level at 1m as per AHRI 575, Shall be not more than 85 dBA.
	(3 W + 1S)
	Refrigerant - R-134a/R-1233ZD (e)
	Evaporator fouling factor: 0.0005 (British Units)
	Condenser fouling factor: 0.001 (British Units)
	5 star label (Incase no manufacturer is found to received 5 star level certification against their chiller, immediate lower star level shall be considered)
	COP & IKW/TR shall be considered with inclusion all losses such as VFD and AHF (Active Harmonic Filter).
	Pressure Drop in Evaporator - 10m (Max)
	Pressure Drop in Condenser - 10m (Max)
	Each Chilling Machine shall comprise
	1 No.-Centrifugal type compressor hermetic/semi hermetic/open complete with automatic capacity control, safety switches, speed increasing gears, forced feed lubrication system etc. as per specifications.
	1 No.-Suitable capacity squirrel cage induction motor with class 'F' Insulation suitable for operation on 415±10% volts, 50 HZ, A.C. Supply. (for open type compressor motor H.P. Shall be at least 10% higher than the compressor BHP requirement at full load).
	1 No. variable frequency drive along with AHF (Active Harmonic Filter) suitable for compressor motor complete with ammeter with CTs, overload protection, under voltage protection, protection against phase reversal & independent single phase preventers etc complete as required. THDi shall be less than or equal to 5% for all load (i.e. 100% to 20% load) at chiller source
	Necessary drive arrangement
	1 Set- lubrication device consisting of automatic electric oil pump, oil cooler, head tank, oil strainer, automatic pressure regulating mechanism, oil heater, thermal switch etc. as per specifications.
	1 No - matching shell and tube water cooled condenser of M.S. shell and integrally finned copper tubes.
	1 No. -matching shell and tube flooded type chiller for centrifugal type units of M.S. shell and integrally finned copper tubes.
	1 Lot- Refrigerant piping fittings, valves and accessories to inter connect compressor, condenser, chillers and expansion valve.

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	1 Set - Microprocessor based control panel complete with accessories as per specifications. Controls shall be suitable for hookup to BMS, compatible with BacNet/ Modbus as per specifications.
	Lot - Refrigerant line accessories comprising of safety valves, angle valves, liquid line indications, liquid level control etc.
	Lot- water flow switches at inlet and outlet of condenser and chiller, water drain and air purge valves wherever required.
	Lot- Suction line and chiller insulation with minimum 25 mm thick polyvinyl nitrile rubber insulation finished with 0.63 mm thick G.S.S. cladding complete as required.
	Lot - Frame work for mounting the above condenser, chiller compressor and motor with base plate complete with ant vibration pads/springs.
	Lot-Initial/first charge of refrigerant gas and compressor oil.
2	WATER COOLED SCREW CHILLER (VFD DRIVE & AHF):
2.1	Supplying, Installing, testing & Commissioning of AHRI Certified screw water chilling machine each having a capacity of 378000 K.CAL/hour(125 TR) at chilled water inlet/ outlet temperature of 52 Deg. F (11.11 Deg. C) / 42 Deg. F (5.55 Deg. C) with chilled water circulation rate of 300 USGPM (nominal) and condenser water inlet/ outlet temperature of 90 Deg. F (32.27 Deg. C)/ 100 Dec. (37.83 Deg. C) with circulation rate 375 USGPM (nominal), suitable for operation on refrigerant R-134A each comprising of the following complete as per specification and as reqd. The scope of work shall include Lifting, shifting & positioning of chiller at location shown on drawing. Chiller shall be capable to unload from 100% to 20% even at constant ECWT of 92 degree Fahrenheit, without surging and without hot gas bypass. Maximum noise sound pressure level at 1m as per AHRI 575, Shall be not more than 86 dBA.
	(1 W + 0S)
	Refrigerant - R-134a
	Evaporator fouling factor: 0.0005 (British Units)
	Condenser fouling factor: 0.001 (British Units)
	5 star label (Incase no manufacturer is found to received 5 star level certification against their chiller, immediate lower star level shall be considered)
	COP & IKW/TR shall be considered with inclusion all losses such as VFD and AHF (Active Harmonic Filter).
	Pressure Drop in Evaporator - 8m (Max)
	Pressure Drop in Condenser - 8m (Max)
	Each Chilling Machine shall comprise
	1 No. Screw type compressor open / semi hermetic complete single/multi circuit with automatic capacity control, safety switches, speed increasing gears, forced feed lubrication system etc. as per specifications.
	1 No.-Suitable capacity squirrel cage induction motor with class 'F' Insulation suitable for operation on 415±10% volts, 50 HZ, A.C. Supply. (for open type compressor motor H.P. Shall be at least 10% higher than the compressor BHP requirement at full load).
	1 No. variable frequency drive along with AHF (Active Harmonic Filter) suitable for compressor motor complete with ammeter with CTs, overload protection, under voltage protection, protection against phase reversal & independent single phase preventers etc complete as required. THDi shall be less than or equal to 5% for all load (i.e. 100% to 20% load) at chiller source
	Necessary drive arrangement
	1 Set- lubrication device consisting of automatic electric oil pump, oil cooler, head tank, oil strainer, automatic pressure regulating mechanism, oil heater, thermal switch etc. as per specifications.
	1 No - matching shell and tube water cooled condenser of M.S. shell and integrally fined copper tubes.

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	1 No. -matching shell and tube flooded type chiller for centrifugal type units of M.S. shell and integrally finned copper tubes.
	1 Lot- Refrigerant piping fittings, valves and accessories to inter connect compressor, condenser, chillers and expansion valve.
	1 Set - Microprocessor based control panel complete with accessories as per specifications. Controls shall be suitable for hookup to BMS, compatible with BacNet/ Modbus as per specifications.
	Lot - Refrigerant line accessories comprising of safety valves, angle valves, liquid line indications, liquid level control etc.
	Lot- water flow switches at inlet and outlet of condenser and chiller, water drain and air purge valves wherever required.
	Lot- Suction line and chiller insulation with minimum 19 mm thick polyvinyl nitrile rubber insulation finished with 0.63 mm thick G.S.S. cladding complete as required.
	Lot - Frame work for mounting the above condenser, chiller compressor and motor with base plate complete with ant vibration pads/springs.
	Lot-Initial/first charge of refrigerant gas and compressor oil.
3	PRIMARY VARIABLE CHILLED WATER PUMPS:
	Supply, Installation, Testing & Commissioning of Primary Variable Chilled Water centrifugal Vertical inline split coupled pumps with VFD, mechanical seal, complete with motor, drain valves and other accessories. Pumps shall have CI casing & Bronze Impeller (ASTM B584 grade C84400)/ Equi, SS Shaft. Seal construction material shall be Steel multi-spring outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. The pump motor shall be of IE-3 class efficiency, TEFC Squirrel cage class -F insulation, suitable for 415 Volts \pm 10%, 50 cycles, 3 phase power supply. Pumps shall be complete as per specifications and shall have operating parameters as given below. The internal components of pumps including mechanical seal shall be suitable to sustain a temperature of 122°F. Pump shall be with PN-16 ratings. minimum efficiency of pump shall be as below. Vendor shall be provide with ant vibration arrangement for pumps as per OEM Standards.
	The variable speed pump shall consist of Variable frequency drive (VFD) with digital touch display panel one for each pump and each VFD shall be pump mounted for unit reliability, VFD shall with IP-55 protection from dust & water. The variable pump VFD shall display dynamic Flow and head for Energy Efficient & precise control of the pumping system offered to capture the unpredictable variations of the circuit installation and system quadratic curves can be optimized at site as per system requirement. This shall be done by the pump in build sensorless logic. The system shall control and adjust the pump quadratic curve as per site actual head requirements.
	The VFD shall be multi-color 4.3" back-lit touch-screen. Variable Pumps must be provided with a cloud-based service that enables Active Performance Management. It must proactively track and manages pump performance and provides early diagnostic messaging, web accessible trends and analysis along with automated reports helping end customer to make performance-based decisions and take immediate action to deliver the best possible HVAC pump performance. The cloud-based services should deliver real-time alerts, alarms & warnings on excessive vibration, Pump in hand, Dead head, Cavitation, Broken Coupling. The connectivity kit supplied by OEM/ authorized representative should have ability to connect up-to 8 pumps in a single plant room.
	Note:- Pump's with VFD should be BMS Compatible (MODBUS/ BACNET)
	Vendor shall be submit software generated selections with details of Pump performance curve & efficiency curve alongwith offer GA drawing for aproval. Manual selections shall not be acceptable.
	The above mentioned pumps shall include following:
3.1	Water flow rate: 950 USGPM, Head : 45 mtrs, efficiency 80% minimum (3W+1S) Chilled Water (For Non-OT chillers)

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
3.2	Water flow rate: 300 USGPM, Head : 45 mtrs, efficiency 75% minimum (1W+1S) Chilled Water (For OT chillers)
3.3	Water flow rate: 90 USGPM, Head : 38 mtrs, efficiency 65% minimum (2W+1S) Hot Water (For Monsoon Re-heat)
4	PRIMARY VARIABLE CHILLED WATER PUMPS CONTROLLER:
	<p>The Above item shall be included with Dedicated microprocessor based pump logic controller, parallel pumping software duly downloaded, sensorless logic, interfacing amongst all components and compatibility of I/O signals, BMS compatible etc complete with other accessories as required. It should be complete as per manufacturer's Specifications VFD shall be capable to operate on Sensorless Control application along with controller. Controller(IP-55) should have parallel pump logic to operate all set of the pumps with the following features:</p> <ul style="list-style-type: none"> -Parallel pump operation for power savings. - Controller shall control pump VFD's as per building load variation. - The bypass line shall be controlled with the pump controller. <p>Microprocessor controller shall not be mounted on any of the VFD and should be standalone system to have equipments better performance/ Efficiency and reliability. The pump logic controller shall be enclosed in an IP55 protection enclosure and shall be able to controller minimum 5nos pumps. The entire system along with secondary pumps must be sourced from pumping system supplier only, for unit responsibility.</p>
4.1	Controller for 4 nos. chilled water primary pumps (For Non-OT area)
4.2	Controller for 2 nos. chilled water primary pumps (For OT area)
4.3	Controller for 3 nos. hot water primary pumps
5	CONDENSER WATER PUMPS:
	<p>Supply, Installation, Testing & Commissioning of Condenser Water centrifugal Vertical inline split coupled pumps with outside type mechanical seal, complete with motor, drain valves and other accessories. Pumps shall have CI casing & Bronze Impeller (ASTM B584 grade C84400)/ Equi, SS Shaft. Seal construction material shall be Steel multi-spring outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. The pump motor shall be of IE-3 class efficiency, TEFC Squirrel cage class -F insulation, suitable for 415 Volts ± 10%, 50 cycles, 3 phase power supply. Pumps shall be complete as per specifications and shall have operating parameters as given below. The components of pumps including mechanical seal shall be suitable to sustain a temperature of 122°F. Pump shall be with PN-16 ratings. minimum efficiency of pump shall be as below. Vendor shall be provide with ant vibration arrangement for pumps as per OEM Standards.</p>
	Vendor shall be submit software generated selections with details of Pump performance curve & efficiency curve along with offer GA drawing for approval. Manual selections shall not be acceptable.
	The above mentioned pumps shall include following:
5.1	Water flow rate: 1425 USGPM, Head : 24 mtrs, efficiency 80% minimum (3W+1S) Condenser Water (For Non-OT chillers)
5.2	Water flow rate: 375 USGPM, Head : 24 mtrs, efficiency 75% minimum (1W+1S) Condenser Water (For OT chiller)
6	COOLING TOWER:

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	Supply, assembly, installation, testing and commissioning of CTI Certified induced draft cross flow cooling tower with side panels in FRP/ Steel construction, FRP / Steel Hot Water & Cold Water basins, Curtain Type PVC fills (13mill thk) & capable to withstand hot water temp. up to 54°C with integral louvers, drift eliminators, completely formed from self-extinguishing polyvinyl chloride (PVC) material (as per ASTM D-568) , having a flame spread rating of 5 per ASTM Standard E84-77a and oxygen index of 32. Hot water basin either fitted with non-clog type spray nozzles or having self-rotating sprinklers, statically balanced axial flow fan, Fan & drive components (fan & motor sheaves) to be made in Aluminum Construction, split bearing shall be provided in fan shaft to divide the load over two bearings, belt driven fans with TEFC/ TEAO induction motor of class F insulation, efficiency class IE-3 suitable for operation on 415 + 10% volts,50 Hz. AC supply. Suction screen in SS Construction, make-up quick fill arrangement, vibration cut out switch, extended lubrication lines, overflow and drain connections with all necessary valves & foot valves, suitable inspection ladder, access door to enter the cooling tower with service platform/ walkway inside the cooling tower for easy access and maintenance shall be provided, steel supporting structure with proper design, anti-vibration mountings, foundation nuts, bolts, painting etc. complete as required and as per specification. For longer life of the product CT structure shall be made out of Hot dip galvanization Sheets which shall be minimum G-235 Grade on the steel frame, ladder & other accessories.
	The scope of work shall include Lifting, shifting & positioning of cooling tower at location shown on drawing. The maximum allowable sound power at a distance of 5 Mt for the cooling Tower on air suction side shall be less than equal to 64 dB. Software selection to be submitted by manufacturer showing the sound ratings as tested in accordance to CTI ATC-128. Drift Loss shall be < 0.0009 % Performance required for cooling tower should be minimum 95 gpm/ HP when tested according CTI ATC-105 procedure. The cooling tower shall be CTI Certified for Thermal performance & Sound shall be tested in accordance with CTI ATC-128, OSHA certified for safety standards & accessories like Ladder & handrail should be as per OSHA guidelines , CQC Certified for water savings
	The following certificates and selections shall be provided for technical submission: CTI Certificate, OSHA Certificate, CQC Certificate, Software selection of cooling tower with sound and thermal performance.
	Note: Fans shall operate with VFD & Motor shall be IE-3 Class. Warrantee of CT & all it's components is by CT manufacturer. Software Selection shall be furnished for the cooling tower selections.
	Ambient temperature
	Monsoon- 91.94 ° F DB, 85.10 ° F WB
	Considered WB for Selection as 86.9 ° F WB
	Inlet temperature of Contenders- 91.9 ° F
	Outlet temperature of Condenser- 101.9 ° F
6.1	Water Flow Rate- 1425 usgpm (3W+1S)
6.2	Water Flow Rate- 375 usgpm (1W+0S)
7	CLOSE EXPANSION TANK:

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	Supply, installation, testing and commissioning of MS Closed Expansion tank with EPDM BUTYL/ Equi membrane for chilled /hot water application (pressurized) complete with piping connections, 2 set of pumps (1W+1S), safety relief valve, drain valve, pressure gauge, painting, control panel etc. as required and as specified. The tank shall be designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions. The tank shall be nitrogen charged steel expansion tank. PRV and Air vent should be installed at site. The unit shall be complete as per technical specification. Tank shall be selected for PN-16 rating. The tank shall be fitted with lifting rings, floor mounting skirt for vertical installation. The tank must be constructed in accordance with section VIII of the ASME Boiler and pressure vessel (Unfired) code and stamped for working pressure.
	Pressurizing unit consisting of centrifugal clear water pumps (1W+1S) with impeller and S.S. 316 shaft, CI Base, TEFC motor (with mechanical seal) with control panel and Set of accessories such as pressure switches, suction and discharge pipe manifolds, pressure gauges, valves etc. conforming to the specifications. This Shall Include Control panel, Set of accessories such as pressure switches, suction and discharge pipe manifolds, pressure gauges, valves etc.
	The complete system(Expansion tank & pressurization unit with control panel shall be given as a single unit.
7.1	4000 litres for For Non-OT chilled water circuit
7.2	2000 litres for For OT chilled water circuit
7.3	1500 litres for For Mansoon Re-heat hot water circuit
8	AIR & DIRT SEPERATOR:
	Supply installation testing and commisioning of Deaerator-dirt separator. Flanged connections, complete with Brass drain valve 1" F (from DN 50 to DN 150), 2" F (from DN 200 to DN 300). complete with a set of concentric metal mesh surfaces to create the swirling motion required to facilitate the release of micro-bubbles and dirt to the surfaces. Epoxy resin coated steel body. Brass automatic air vent valve body. Stainless steel internal element. PP float. Brass float guide and stem. Stainless steel float lever and spring. EPDM hydraulic seals. Medium water and non-hazardous glycol solutions excluded from the guidelines of EC directive 67/548; maximum percentage of glycol 50%. Maximum working pressure PN 16, Working temperature range 0–110°C. Particle separation rating down to 5µ. Working temperature range 0–100°C. Floor brackets as per site requirement. Third Party test report is required to be submit by contractor from manufacturer for 5µ Particle separation (TNO)
8.1	DIA-400 mm
8.2	DIA-100 mm
8.3	DIA-80 mm
9	AUTOMATIC TUBE CLEANING SYSTEM:

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	Supply, installation, testing and commissioning of AUTOMATIC TUBE CLEANING SYSTEM with Anti Fouling arrangement on chiller by automatic condenser cleaning Upton 5# Chillers Max, with a Common Skid for the required number of chillers in the plant room. The system shall include IoT Ready, Industry 4.0 complaint device. The Panel should have minimum 7" Touch Screen Graphical HMI which will log the real time data related to chiller energy (KWH), Capacity (TR), Chiller Water Flow monitoring, Water Temperature profile on evaporator and condenser both and graphical representation of historic summary which shall be displayed on the Mobile App with unlimited user access on cloud based system. The data should also be retrieved in XL or PDF Format. The skid shall have IOT Panel, Injection/Collection pump, Motorized Valves & Fittings. Field Devices like Energy Meter, Flow Meter, Temp. Sensors shall be picked up from BMS/CPO Scope of Supply & Data shall be replicated from skid via Modbus protocol. The Common Skid piping, Ball Trap Size to suit chiller capacity requirement for the project.
9.1	Suited for 4x475 TR chiller (3W+1S) + 1x125TR chiller (1W+0S)
10	ELECTRO-CHEMICAL TREATMENT SYSTEM FOR COOLING TOWER (NON-CHEMICAL) FOR COOLING TOWER TREATMENT:
	Supply, installation, testing and commissioning of Electro-Chemical Treatment System for Cooling Tower (Non-Chemical) for Cooling Tower Treatment. The system should be equipped with Automatic Self Cleaning Mechanism & Automatic Blow down Control. The proposed system should be manufactured and complied with ISO 14001:2015, ISO 9001:2015. The system must be CE + RoHS compliant and in accordance with UL standards. The proposed system should minimize blow down water consumption up to 50%. No/Zero Chemicals uses for cooling tower circuit, technology must fall under green technology initiatives, the system must avoids algae and micro-bacterial formation in water or surface of Pipe/ CT/ fills. The system must have components like - Electrolytic Reactor, Automated Scrapper mechanism for reactor cleaning, Automatic Blow down control, Side Screen Filter, Automatic Back wash Feature, Control Panel, Skid with Pumps & Valves.
10.1	Suited for Working Designed Flow rate: 6450 GPM
11	HOT WATER GENERATOR:
	Supply, installation, testing and commissioning of electrically operated Hot Water Generator of following nominal capacity having 10mm thick shell of mild steel sheet, 12mm thick dish end of mild steel sheet, 1mm thick stainless steel lining with heaters arranged in banks and controlled by electronic controller and thermostats could be supplied including 50mm thick fibre glass / mineral wool / insulation finished with 1.25mm thick G.I. sheet cladding including necessary electrical panel board, having suitable incoming & outgoing switch gears for boiler and pump automatic controls including inlet and outlet connections for water, along with pressure relife valve & safety huttor foundation for boiler as per specifications complete as required.
	Outlet temperature of HWG- 45 ° C
	Inlet temperature of HWG- 40 ° C
11.1	350 KW, 266 USGPM (2W+1S), for Space Heating
11.2	120 KW, 90 USGPM (2W+1S), for Monsoon Re-heat
12	CHILLER PLANT OPTIMIZER:
	SUPPLY, INSTALLATION, TESTING, COMMISSIONING & HANDING OVER OF THE FOLLOWING:
12.1	CENTRAL CONTROL SERVER
a	<ul style="list-style-type: none"> • Intel® Xeon® CPU E5-2640 x64 (or better) compatible with dual and quad core processors; • Windows 11 (64 bit), Enterprise, Ultimate, 64 bit), Windows Server 2012 R2 (Standard, Enterprise, 64 bit); Windows Server 2016;•8 GB minimum, 16 GB or more recommended for larger systems ; • Video card and monitor capable of displaying at 1024 x 768 resolution, or

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	greater; •If enterprise-level data archiving is required (optional)one of the following compatible database applications will need to be installed (MS SQL Server 2012 or MS SQL Server 2016)
b	Client PC System: Intel core i3 2.93 GHz,E7500,3mb cache,1066Mhz FSB, 4GB DDR3-1066/1333 Expandable up to 8GB, 500 GB SATA Hard Disk, DVD Writer, Lan Card 10/100/1000 base-T, Optical Mouse, 104 Keys Keyboard, Windows 11, Inbuilt graphics Intel chipset (1 GB NVIDIA graphics media accelerator card),
c	A 4 size Inkjet colour Printer suitable for the application, with driver software.
e	Display monitore for BMS Graphical User Interface - LED 32 Inch
	Supply, Installation, Testing & Commissioning of 10/100/1000 Base-T Switch with IP multicast snooping and data-driven IGMP support and with 1000 baseT FO uplink ports and all related termination accessories as per vendor specific System requirement. (Pigtail,Sleeve, Patch Chords, termination etc)
a	8 Port Switch
12.2	SOFTWARE
a	Supply, Installation, Testing and Commissioning of BMS System Software : The BMS GUI software should not require additional software (to enable a standard Web browser) to be resident on the DDC / client machine, or manufacture-specific browsers shall not be acceptable. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Storage of the graphical screens (Static) shall be stored in DDC directly and should not depend on any other hardware. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. This data shall reside on a server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a Master / Global / Host to pass data shall NOT be acceptable. Physical connection of BACnet devices shall be via Ethernet at all levels. The License must be provided with mimimun of 25 concurrent user licenses by default. 25 analytic points license should be included with software by default. Life Time License
12.3	DDC CONTROLLERS WITH IP
	DDC CONTROLLERS : Supply, Installation, Testing and Commissioning of IP Based DDC controllers. DDC controllers shall be capable of fully "stand- alone" operation i.e. In the event of loss of communication with other DDC's or Control Station, they shall be able to function on their own. The controllers shall consist of single/dual 32 bit microprocessors for reliable throughput, with EPROM based operating system on BACNET. Master Slave Topology is NOT acceptable. The Controller which route the messages or data sharing through the system or any intermediate hard ware / controller shall not be acceptable. Each DDC on field level shall have embedded TCP/IP (10/100Mbps) connectivity so that it can be hooked into the Local Area Network (LAN) provided by the client / can be on dedicated network created by the vendor. Each DDC can be accessed from the Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server. All controllers shall accept 230V, 50Hz Uninterrupted power supply, provided by end user, directly so that the in between hardware such as transformers and SMPS are avoided. Controller shall support DHCP addressing over Local Area Network (LAN) so that the static IP requirements are reduced however a single static IP shall be provided for system so that it can be hosted on to internet in consultation with end user / consultant. The microprocessor based DDC's shall be provided with power supply, A/D and D/A converters, memory and capacity to accommodate a maximum of 192 input/output (I/O) hardware points (with or without an expansion board). Each DDC should have minimum 10 UI & 6 AO points on board without any expansion module. 15% spares should be considered. Each DDC on field level should have minimum 128MB RAM & 64MB Flash memory. All controllers should be mandatorily BTL Approved with B-BC profile.
3.a	DDC Controller for Plant Room Optimizer
12.4	PORTABLE OPERATOR TERMINAL

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	Portable Operator Terminal : capable of connecting to one of the Controllers on the Communication bus and view parameters of the complete system. The Terminal should be capable of viewing / changing parameters and trend the specified parameters as per requirement
12.5	INTEGRATION
	The 3rd party Integration unit shall provide the interface between Ethernet LAN and the 3rd party field control devices or any other devices which need to be integrated. These shall also provide supervisory capability of functions over the devices connected to it. The purpose of using these units should be limited to integrate devices only, not for any DDC interface with GUI, provided by others. The Unit must provide the following hardware features as a minimum: a. Two No. on Board RS-485 port b. Provision to include / add additional communication card c. Two onboard Ethernet port d. 4GB memory The Integration unit shall provide flexibility of adding communication ports (RS485) by adding communication cards, minimum one slot, when required rather than adding additional unit itself. The Integration unit should have inbuilt memory for program storage. The Unit must communicate over TCP/IP with communication speed of 10/100MBPS.25 analytic points license should be included with third party integrator by default. The Integration unit should be capable of handling multiple protocol simultaneously and should not be restricted to single protocol such as Bacnet, Modbus, M-Bus, KNX, SNMP.All integrators should be mandatorily BTL listed.
12.6	SENSORS AND FIELD DEVICES
	Supplying, installing, testing and commissioning of the following sensors / transducers / transmitters
a	DP Switch Air for CT Fans
b	DP Switch Water for Pumps
c	Water Flow Switch
d	Immersion Temp Sensor
e	Water Level Switch CT
f	Water Level Sensor for Make tanks
g	Water Pressure Sensor
h	Outside CO2 Sensor
i	Outside Temp & RH Sensor
12.7	CABLES
a	Supplying, installing, testing and commissioning of 2 Core X 1.0 Sqmm Shielded armoured Flexible Copper Cable (per I/O points hard wired to DDC).
b	Supplying, installing, testing and commissioning of 4 Core X 1.0 Sqmm Shielded armoured Copper Cable (per Soft I/O points to DDC).
c	Supplying, installing, testing and commissioning of Cat6e cable (for networking).
12.8	Supply and providing of MS Powder Coated Perforated cable tray complete with all fittings, bends, supports and accessories
a	150mmX50mmX2mm
b	450mmX50mmX2mm
b	300mmX50mmX2mm
B	AIR-CIRCULATION SYSTEM:
1	AIR COOLED INVERTER HI WALL UNIT:

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	Supply, Installation, Testing and Commissioning of inverter air cooled Split air-conditioning unit of BEE 5 star rating consist of outdoor unit, indoor unit wireless remote control the outdoor unit shall comprise of rotary / reciprocating compressor, referigent should be CFC free, air-cooled condenser, fan, fan motor with corded remote controller, electrical accessories & suitable stand of MS angle iron painted with anti-rusted treatment for installation of outdoor unit the indoor unit shall be decorative Hi-wall type complete with cooling coil, drain pan washable pre filter first charge of referigent complete with suitable capacity voltage stabilizer etc as reqd for voltage range of 100V~300V. Unit shall be supplied fully refrigerant charged plus additional top up of refrigerant to suit piping length. Unit shall be suitable for working under long length of refrigerant piping up to 20 meter minium. Refrigerant piping (Pair) up to 20 meter price to be included . The condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air.
1.1	2.0 TR Capacity (2W+1S)
C	WATER PIPING:
	Chilled/Hot Water System
1	Supplying, laying/ fixing, testing and commissioning of following nominal sizes of chilled water piping plumbing inside the building (with necessary clamps, vibration isolators and fittings but excluding valves, strainers, gauges etc.) duly insulated with fire retardant quality expanded polystrene moulded pipe section of density 20 kg/cu.m after a thick coat of cold setting adhesive (CPRX compound) wrapping with 500g polythene faced hessain and finally applying 0.63mm aluminum sheet cladding complete with type3 , grade 1 roofing feltstrip(as per IS:1322 as amended up to date) at joints repairing of damage to building etc. as per specifications and as required complete in all respect. The pipes shall be joined using Grooved Fittings conforming to ASTM Grade A-536. The Grooved Couplings shall be Standard OGS Groove from 20 NB - 12". Installation Ready Coupling shall be used from 2"-12" and shall be conform to AGS Grooving from 14" & above
	Note:-The Pipes of sizes 150mm & below shall be M.S. 'C' class as per IS : 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes upto 350 mm dia. and from minimum 7mm thick MS sheet for pipes of 400 mm dia and above. The pipes shall be joined using Grooved Coupling
1.1	400 mm dia MS pipes (75 mm insulation)
1.2	350 mm dia MS pipes (75 mm insulation)
1.3	200 mm dia MS pipes (75 mm insulation)
1.4	150 mm dia MS pipes (75 mm insulation)
1.5	125 mm dia MS pipes (75 mm insulation)
1.6	100 mm dia MS pipes (50 mm insulation)
1.7	80 mm dia MS pipes (75 mm insulation)
1.8	65 mm dia MS pipes (75 mm insulation)
2	Pre-Insulated Buried Chilled Water Piping PUF Insulation):
	Supplying, laying/ fixing, testing and commissioning of following nominal sizes of chilled water piping shall be of pre insulated type, as Pipes per specs mentioned here in. The pre insulated pipe shall comprise of a carrier steel pipe, insulated with pressure injected, CFC free, PUF insulation with density not less than 40 Kg/CuM within a jacket covering. Material, type and wall thickness of carrier pipe shall be, as specified earlier. The pipe insulation shall be polyurethane foam having density of 36 kg/cum minimum, 90% minimum closed cell content, minimum compressive strength of 2.8 kg/ sqcm and thermal conductivity of 0.017 W/mk confirming to IS-12346.

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	Note:- The Pipes of sizes 150mm & below shall be M.S. 'C' class as per IS : 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes upto 350 mm dia. and from minimum 7mm thick MS sheet for pipes of 400 mm dia and above.
	HDPE Insulation jacket- Buried pipe- The outer protective jacket shall be seamless, extruded, black, UV resistant High density, polyethylene (HDPE).The HDPE pipe shall have PN 2.5 rating, PE 80 type. The HDPE pipe shall confirm to IS 894. HDPE jacketing shall be used for underground buried pipe, where pipes are backfilled with soil. Rate shall include field kit.
2.1	350 mm dia MS pipes (64 mm insulation) (7.8 mm jacketing)
2.2	200 mm dia MS pipes (63 mm insulation) (5.0 mm jacketing)
2.3	150 mm dia MS pipes (53 mm insulation) (4.4 mm jacketing)
2.4	100 mm dia MS pipes (40 mm insulation) (3.2 mm jacketing)
2.5	80 mm dia MS pipes (43 mm insulation) (3 mm jacketing)
2.6	65 mm dia MS pipes (39 mm insulation) (3.0 mm jacketing)
2.7	50 mm dia MS pipes (37 mm insulation) (3 mm jacketing)
2	Condensate Drain Piping:
	Providing and fixing G.I. pipes complete with G.I. fittings and clamps, i/c cutting and making good the walls etc for condensate drain.
2.1	40 mm dia
3	Condensate Drain Piping Insulation:
	Supplying, laying/ fixing of following thickness insulation with fire retardant quality expanded polystyrene moulded pipe section of density 20 kg/cu.m after a thick coat of cold setting adhesive (CPRX compound) wrapping with 500g polythene faced hessain and finally applying 0.63mm aluminium sheet cladding complete with type3 , grade 1 roofing feltstrip(as per IS:1322 as amended up to date) at joints repairing etc. as per specifications and as required complete in all respect.
3.1	50 mm
4	Insulated Valves:
	Supplying, fixing, testing and commissioning of following valves, strainers, gauges in the chilled water plumbing duly insulated to the same specifications as the connected piping and adequately supported as per specifications.
4.1	BUTTERFLY VALVE (MANUAL) with C I body SS Disc, Nitrile Rubber Seal & O- Ring PN 16 pressure rating for chilled water/ hot eater circulation as specified.
4.1.1	200 mm dia
4.1.2	100 mm dia
4.1.3	65 mm dia
4.2	BUTTERFLY VALVE (Motorized) with C I body SS Disc, Nitrile Rubber Seal & O- Ring PN 16 pressure rating for chilled water/ hot eater circulation as specified.
4.2.1	200 mm dia
4.2.2	100 mm dia
4.2.3	65 mm dia
4.3	BALANCING VALVE WITH BUILT IN MEASURING FACILITY with C I body flanged construction with EPDM coated disc with long pitch with protected out pipe insulation & PN 16 pressure rating for chilled/ hot water circulation as specified.
4.3.1	200 mm dia
4.3.2	100 mm dia
4.3.3	65 mm dia

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
4.4	NON - RETURN VALVE with duel plate of C I body SS plates vulcanized NBR seal flanged end & PN 16 pressure rating for chilled / hot water circulation including insulation as specified.
4.4.1	200 mm dia
4.4.2	100 mm dia
4.4.3	65 mm dia
4.5	Y - STRAINER of Ductile CI Body flanged ends with stainless steel strainer for chilled/ hot water circulation including insulation as specified.
4.5.1	200 mm dia
4.5.2	100 mm dia
4.5.3	65 mm dia
4.6	Providing and fixing in position the industrial type pressure gauges with gun metal / brass valves complete as required.
4.7	Providing & fixing in position the mercury in glass industrial type thermometers.
4.8	Automatic air vent
4.8.1	Supply, installation, testing and commissioning of 10mm dia. Automatic air vent in brass construction complete with nipples, union etc. as required at all high points in the pipe lines. The valve shall be such as to have non-return valve as integral part of the vent.
5	CONDENSER WATER PIPE
	Supplying, fixing, testing and commissioning of condenser water Supplying, fixing, testing and commissioning of condenser water pipes of following sizes of MS 'C' class along with necessary clamps, vibration isolators and fittings such as bends, tees etc. but excluding valves, strainers, gauges etc. adequately supported on rigid supports duly painted/buried in ground excavation and refilling etc. as per specification and as required complete in all respect. clamps, vibration isolators and fittings such as bends, tees etc. but excluding valves, strainers, gauges etc. adequately supported on rigid supports duly painted/buried in ground excavation and refilling etc. as per specification and as required complete in all respect. The pipes shall be joined using Grooved Fittings conforming to ASTM Grade A-536. The Grooved Couplings shall be Standard OGS Groove from 20 NB - 12". Installation Ready Coupling shall be used from 2"-12" and shall be conform to AGS Grooving from 14" & above
	Note:-The Pipes of sizes 150mm & below shall be M.S. 'C' class as per IS : 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes upto 350 mm dia. and from minimum 7mm thick MS sheet for pipes of 400 mm dia and above. The pipes shall be joined using Grooved Coupling
5.1	500 mm dia.
5.2	250 mm dia.
5.3	150 mm dia.
5.4	50 mm dia.
6	VALVES WITHOUT INSULATION
	Supplying, fixing, testing and commissioning of following valves, gauges and strainers for condenser water circulation as per specifications.
6.1	BUTTERFLY VALVE (MANUAL) with C I body SS disc nitrile sheet & O - ring & PN 16 pressure rating as specified.
6.1.1	500 mm dia.

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
6.1.2	250 mm dia.
6.1.3	150 mm dia.
6.1.4	50 mm dia.
6.2	BUTTERFLY VALVE (Motorized) with C I body SS Disc, Nitrile Rubber Seal & O- Ring PN 16 pressure rating for chilled water/ hot eater circulation as specified.
6.2.1	250 mm dia.
6.2.2	150 mm dia.
6.3	NON - RETURN VALVE with dual plate of CI body SS plates vulcanized NBR seal flanged end & PN 16 pressure rating as specified.
6.2.1	250 mm dia.
6.2.2	150 mm dia.
6.4	Y - STRAINER of Ductile CI Body flanged ends with stainless steel strainer for chilled/ hot water circulation including insulation as specified.
6.4.1	250 mm dia.
6.4.2	150 mm dia.
6.5	BALANCING VALVE WITH BUILT IN MEASURING FACILITY with C I body flanged construction with EPDM coated disc with long pitch with protected out pipe insulation & PN 16 pressure rating for chilled / hot water circulation as specified.
6.5.1	250 mm dia.
6.5.2	150 mm dia.
7	Groove Fittings:
	Providing, laying, jointing, testing and commissioning of following sizes of Grooved Couplings & Grooved Fittings in pipes for Chilled Water and Condenser Water Lines including all accessories. The Grooved Fittings shall be supplied by manufacturer of grooved Couplings The Couplings should not need any torque to tighten upto 12". Tongue & Recess Couplings are not allowed. Angle Pad Design Grooved Couplings are allowed. The Minimum working pressure rating should be above 400 psi for these sizes upto 12" The Couplings from 14" and above should need AGS Groove Welding is not allowed to join pipes
7.1	Grooved Couplings
7.1.1	500 NB with Grade "E" FlushSeal™ EPDM having temperature rating between -34°C to +110°C
7.1.2	400 NB with Grade "E" FlushSeal™ EPDM having temperature rating between -34°C to +110°C
7.1.3	250 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
7.1.4	200 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
7.1.5	150 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
7.1.6	125 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
7.1.7	100 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
7.1.8	80 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
7.1.9	65 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
7.2	Grooved Elbows

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
	Supply, Installation, Testing & Commissioning of long casing(GSS) Vane/Tube Axial flow type fans complete with aluminium alloy blades with aerofoil design, bird screen, flexible connection & gravity louvers at outlet. Motor shall be of 415 + 10% volts, 50 Hz. Sound level at 3mt distance from fan outlet shall not be more than 80db(A) (Room Condition). Capacity shall be as follows & as per detailed technical specification: Fans should be AMCA certified. Manufacturer shall submit "Certificate of conformity for 250 deg for 2 hours operation as per EN12101-3: 2002 issued by Internationally recognized Independent Fire Laboratory should be submitted along with type test report. The Type test report should clearly indicate the make of motor used during the testing and the same make/model of motor should be supplied by the fan manufacture at the site." RPM Should Not exceed 950. However lower cfm upto 5000 CFM can be provided at 2850 RPM. Outlet velocity shuld not exceed 13 m/s
1.1	24000 CFM at 45 mm static pressure
1.2	13000 CFM at 30 mm static pressure
2	FANS FOR SUPPLY AIR IN CASE OF NORMAL
	Supply, Installation, Testing & Commissioning of long casing(GSS) Vane/Tube Axial flow type supply air fans complete with aluminium alloy blades with aerofoil design, bird screen, flexible connection & gravity louvers at outlet. Motor shall be of 415 + 10% volts, 50 Hz. Sound level at 3mt distance from fan outlet shall not be more than 80db(A) (Room Condition). Capacity shall be as follows & as per detailed technical specification: Fans should be AMCA certified. RPM Should Not exceed 950.However lower cfm upto 5000 CFM can be provided at 2850 RPM. Outlet velocity shuld not exceed 13 m/s
2.1	21500 CFM at 35 mm static pressure
2.2	13000 CFM at 30 mm static pressure
3	PROPELLER FAN
	Supply, Installation, Testing and commissioning etc as required, wall mounted propeller type exhaust fans shall be of Axial Flow type with light weight type PVC/ aluminium impellers with aerofoil contours for high efficiency and low noise. The fan shall be supplied complete with wooden frames and gravity louvers with a suitable Squirrel cage induction motor. Fan should be AMCA certified.
3.1	450 mm dia
3.2	300 mm dia
3.3	230 mm dia
E	DUCTING AND GRILLES
1	Ducting
	Supply, installation, balancing and commissioning of factory fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following gauges:- Note: Fabrication and jointing of duct shall be as per IS standard and hanging shall be as per SMACNA.
1.1	Thickness 0.63 mm sheet
1.2	Thickness 0.80 mm sheet
1.3	Thickness 1.00 mm sheet
1.4	Thickness 1.25 mm sheet

SCHEDULE OF ITEMS FOR HVAC WORKS (High Side & Service Building)	
S. No.	Description of item
2	Supply, installation, balancing and commissioning of Site fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following gauges:-
2.1	Thickness 0.63 mm sheet
2.2	Thickness 0.80 mm sheet
2.3	Thickness 1.00 mm sheet
2.4	Thickness 1.25 mm sheet
3	Supply, installation, testing and commissioning of GI volume control duct damper complete with neoprene rubber gaskets, nuts, bolts, screws linkages, flanges etc., as per specifications.
4	Supplying & fixing of powder coated extruded aluminium Supply Air Grills/ exhaust with aluminium volume control dampers as per specifications.
5	Supplying & fixing of powder coated extruded aluminium Supply/Return Air Grills with louvers but without volume control dampers complete as required.
6	Supplying, fixing testing commissioning of supply air diffusers of powder coated aluminium with aluminium volume control dampers with anti smudge ring & removable core.
7	Supplying, fixing testing commissioning of Return air diffusers of powder coated aluminium without volume control dampers with anti smudge ring & removable core.
8	Supplying, Fixing,testing and commissioning of fire dampers in supply air duct/main branch and return air path as and where required of required sizes i/c control wiring,the damper shall be motorized and spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored. The spring return action shall be inbuilt mechanism and not externally mounted. The damper shall also be closed in the event of fire signal complete as required and as per specifications.
8.1	Fire damper
8.2	Actuator

Hospital Building

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
A	AIR-CIRCULATION SYSTEM:
1	FLOOR MOUNTED AIR HANDLING UNIT (FOR NONCRITICAL AREA):
	Supply, Installation, Testing and commissioning of factory fabricated Double skinned construction with Thermal Break Profile with (0.8mm) pre coated GSS from outside & (0.8mm) GSS on inside with PUF Insulation of casing thickness (min. 40 mm) and density (min. 42± 2kg/cum) between them. AHU may be floor mounted & should be of sufficient Tonnage, CFM & static pressure as per requirements.
	Maximum air face velocity across filters/Coils shall be 2m/sec. Velocity & friction factor for Pipe Sizing shall be in conformance to relevant standards. Volume control dampers to be provided in ducts as per requirements. TEFC drive IE-3 motor suitable for 415 ± 10% volts, 50Hz, 3 Phase AC supply. All AHUs shall be equipped with VFDs. Fan should be backward curved Airfoil blade Plug Type for supply/exhaust. Fans must be selected for suitable Static Pressure & CFM. Multiple plug fans should be selected with minimum efficiency of 70%. All AHUs shall be space provision for Electronic Air Filtration System (MERV-14) & AHU coil mounted UVGI system. Cooling/Heating Coil of required OD & thickness made of Copper with Fins made of Aluminum with suitable fins/inch. Cooling/Heating Coils Row deep should be considered meeting the functional requirements. Header must be in copper. Drain Pan of AHUs must be made of Stainless Steel of Suitable thickness (20 G). AHU floor should be insulated with 50mm thick throughout the unit.
	The AHU shall have suitable interlock to switch off the UV lamps whenever someone open the door of HRU. The HRU shall also have suitable interlock to switch on and off the UV lamps & ESP filter as per HRU operation.
	Limit switches with control wiring at fan sections doors to switch off the fans motors when fans sections are opened. Price to include light point, light within the fans sections along with wiring & earthing.
	DDC Panel & Instrument kit to be considered
	Actual static pressures shall be checked by the vendor and consider accordingly and no extra cost shall be paid later in case any change of static pressure required during execution.
	The total static pressure to be considered taking maximum pressure drop of all other components of AHU including filters in full dirty condition.
	Suitable Foundation for Floor Mounted AHUs should be considered with anti-vibration pads. Fire retardant double canvass connection should be considered.
1.1	Airflow = 14000 cfm / TSP = 500 Pa / Cooling Capacity = 43.65 TR / Horizontal / Fresh Air= 2200 cfm, 6RD Cooling Coil, with Mixing Box
1.2	Airflow = 13500 cfm / TSP = 550 Pa / Cooling Capacity = 26.99 TR / Horizontal / Fresh Air= 568 cfm, 6RD cooling Coil, with Mixing Box, Outdoor Type
1.3	Airflow = 12500 cfm / TSP = 500 Pa / Cooling Capacity = 28.54 TR / Horizontal / Fresh Air= 645 cfm, 6RD Cooling Coil
1.4	Airflow = 12500 cfm / TSP = 550 Pa / Cooling Capacity = 24.69 TR / Horizontal / Fresh Air= 424 cfm, 6RD cooling Coil, with Mixing Box, Outdoor Type
1.5	Airflow = 12000 cfm / TSP = 500 Pa / Cooling Capacity = 46.11 TR / Horizontal / Fresh Air= 2870 cfm, 6RD Cooling Coil

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
1.6	Airflow = 11000 cfm / TSP = 500 Pa / Cooling Capacity = 33.2 TR / Horizontal / Fresh Air= 1500 cfm, 6RD Cooling Coil, with Mixing Box
1.7	Airflow = 11000 cfm / TSP = 500 Pa / Cooling Capacity = 31.87 TR / Horizontal / Fresh Air= 1692 cfm, 6RD Cooling Coil
1.8	Airflow = 9500 cfm / TSP = 500 Pa / Cooling Capacity = 35.38 TR / Horizontal / Fresh Air= 2435 cfm, 6RD Cooling Coil
1.9	Airflow = 9500 cfm / TSP = 500 Pa / Cooling Capacity = 20.51 TR / Horizontal / Fresh Air= 485 cfm, 6RD Cooling Coil, with Mixing Box
1.10	Airflow = 9000 cfm / TSP = 500 Pa / Cooling Capacity = 29.34 TR / Horizontal / Fresh Air= 1735 cfm, 6RD Cooling Coil
1.11	Airflow = 9000 cfm / TSP = 500 Pa / Cooling Capacity = 29.94 TR / Horizontal / Fresh Air= 1726 cfm, 6RD Cooling Coil
1.12	Airflow = 9000 cfm / TSP = 550 Pa / Cooling Capacity = 29.78 TR / Horizontal / Fresh Air= 2087 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
1.13	Airflow = 8500 cfm / TSP = 550 Pa / Cooling Capacity = 31.94 TR / Horizontal / Fresh Air= 2271 cfm, 6RD Cooling, with Mixing Box, Outdoor Type
1.14	Airflow = 8000 cfm / TSP = 550 Pa / Cooling Capacity = 29.75 TR / Horizontal / Fresh Air= 1986 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
1.15	Airflow = 8000 cfm / TSP = 550 Pa / Cooling Capacity = 26.25 TR / Horizontal / Fresh Air= 1486 cfm, 6RD Cooling, with Mixing Box, Outdoor Type
1.16	Airflow = 7500 cfm / TSP = 550 Pa / Cooling Capacity = 27.63 TR / Horizontal / Fresh Air= 1973 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
1.17	Airflow = 7500 cfm / TSP = 550 Pa / Cooling Capacity = 26.21 TR / Horizontal / Fresh Air= 1704 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type.
1.18	Airflow = 6000 cfm / TSP = 500 Pa / Cooling Capacity = 21.74 TR / Horizontal / Fresh Air= 1950 cfm, 6RD Cooling Coil
1.19	Airflow = 7000 cfm / TSP = 550 Pa / Cooling Capacity = 25.36 TR / Horizontal / Fresh Air= 1770 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
1.20	Airflow = 7000 cfm / TSP = 500 Pa / Cooling Capacity = 24.88 TR / Horizontal / Fresh Air= 1736 cfm, 6RD Cooling Coil, with Mixing Box
1.21	Airflow = 7000 cfm / TSP = 500 Pa / Cooling Capacity = 23.14 TR / Horizontal / Fresh Air= 1365 cfm, 6RD Cooling Coil
1.22	Airflow = 5500 cfm / TSP = 500 Pa / Cooling Capacity = 20.86 TR / Horizontal / Fresh Air= 1367 cfm, 6RD Cooling Coil
1.23	Airflow = 5500 cfm / TSP = 550 Pa / Cooling Capacity = 20.71 TR / Horizontal / Fresh Air= 1493 cfm, 6RD Cooling, with Mixing Box, Outdoor Type
1.24	Airflow = 5500 cfm / TSP = 550 Pa / Cooling Capacity = 20.13 TR / Horizontal / Fresh Air= 1513 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
1.25	Airflow = 5500 cfm / TSP = 550 Pa / Cooling Capacity = 20.08 TR / Horizontal / Fresh Air= 1513 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
1.26	Airflow = 5500 cfm / TSP = 550 Pa / Cooling Capacity = 20.0 TR / Horizontal / Fresh Air= 1516 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
1.27	Airflow = 5500 cfm / TSP = 550 Pa / Cooling Capacity = 14.14 TR / Horizontal / Fresh Air= 571 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
1.28	Airflow = 5000 cfm / TSP = 550 Pa / Cooling Capacity = 13.59 TR / Horizontal / Fresh Air= 473 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
1.29	Airflow = 3500 cfm / TSP = 550 Pa / Cooling Capacity = 8.37 TR / Horizontal / Fresh Air= 398 cfm, 6RD Cooling, with Mixing Box, Outdoor Type
1.30	Airflow = 3000 cfm / TSP = 550 Pa / Cooling Capacity = 8.37 TR / Horizontal / Fresh Air= 398 cfm, 6RD Cooling, with Mixing Box, Outdoor Type
1.31	Airflow = 2100 cfm / TSP = 550 Pa / Cooling Capacity = 12.6 TR / Horizontal / Fresh Air= 125 cfm, 6RD Cooling Coil, with Mixing Box, Outdoor Type
2	FLOOR MOUNTED AIR HANDLING UNIT (FOR CRITICAL AREA):

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	Supply, Installation, Testing and commissioning of factory fabricated Double skinned construction with Thermal Break Profile with (0.8mm) pre coated GSS from outside & (1.0mm) Aluminum on inside with PUF Insulation of casing thickness (min. 40 mm) and density (min. 42 ± 2 kg/cum) between them. AHU may be floor mounted & should be of sufficient Tonnage, CFM & static pressure as per requirements. It should comply a minimum of following Eurovent Standards to fulfil the requirements of Energy Efficiency class and performance of the Air Handling Units. i. Casing Leakage Class (-400Pa and +700Pa) - L1 ii. Casing Mechanical Strength - D1 iii. Thermal Bridge - TB2 iv. Thermal Transmittance - T2 and v. Filter Bypass Factor - F9.
	Maximum air face velocity across filters/Coils shall be 2m/sec. Velocity & friction factor for Pipe Sizing shall be in conformance to relevant standards. Volume control dampers to be provided in ducts as per requirements. TEFC drive IE-3 motor suitable for $415 \pm 10\%$ volts, 50Hz, 3 Phase AC supply. All AHUs shall be equipped with VFDs. Fan should be backward curved Airfoil blade Plug Type for supply/exhaust. Fans must be selected for suitable Static Pressure & CFM. Multiple plug fans should be selected with minimum efficiency of 70%. All AHUs shall be space provision for Electronic Air Filtration System (MERV-14) & AHU coil mounted UVGI system. Cooling/Heating Coil of required OD & thickness made of Copper with Fins made of Aluminum with suitable fins/inch. Cooling/Heating Coils Row deep should be considered meeting the functional requirements. Header must be in copper. Drain Pan of AHUs must be made of Stainless Steel of Suitable thickness (20 G). AHU floor should be insulated with 50mm thick throughout the unit.
	The AHU shall have suitable interlock to switch off the UV lamps whenever someone open the door of HRU. The HRU shall also have suitable interlock to switch on and off the UV lamps & ESP filter as per HRU operation.
	Limit switches with control wiring at fan sections doors to switch off the fans motors when fans sections are opened. Price to include light point, light within the fans sections along with wiring & earthing.
	Actual static pressures shall be checked by the vendor and consider accordingly and no extra cost shall be paid later in case any change of static pressure required during execution.
	DDC Panel & Instrument kit to be considered
	The total static pressure to be considered taking maximum pressure drop of all other components of AHU including filters in full dirty condition.
	Suitable Foundation for Floor Mounted AHUs should be considered with anti-vibration pads. Fire retardant double canvass connection should be considered.
	Whole AHU shall be Eurovent certified.
2.1	Airflow = 12500 cfm / TSP = 500 Pa / Cooling Capacity = 45.41 TR / Horizontal / Fresh Air= 3234 cfm, 6RD cooling Coil+2RD Heating Coil, with Mixing Box
2.2	Airflow = 12000 cfm / TSP = 500 Pa / Cooling Capacity = 107.46 TR / Horizontal / Fresh Air= 12000 cfm, 8RD cooling Coil+2RD Heating Coil, with Mixing Box
2.3	Airflow = 12000 cfm / TSP = 550 Pa / Cooling Capacity = 54.87 TR / Horizontal / Fresh Air= 4094 cfm, 6RD Cooling+2RD Heating Coil, with Mixing Box, Outdoor Type
2.4	Airflow = 9500 cfm / TSP = 500 Pa / Cooling Capacity = 52.46 TR / Horizontal / Fresh Air= 4682 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box
2.5	Airflow = 7500 cfm / TSP = 500 Pa / Cooling Capacity = 58.19 TR / Horizontal / Fresh Air= 6170 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box
2.6	Airflow = 7000 cfm / TSP = 500 Pa / Cooling Capacity = 24.27 TR / Horizontal / Fresh Air= 2032 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box
2.7	Airflow = 7000 cfm / TSP = 500 Pa / Cooling Capacity = 14.34 TR / Horizontal / Fresh Air= 502 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box
2.8	Airflow = 6500 cfm / TSP = 550 Pa / Cooling Capacity = 24.58 TR / Horizontal / Fresh Air= 2181 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box, Outdoor Type

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
2.9	Airflow = 6000 cfm / TSP = 550 Pa / Cooling Capacity = 34.86 TR / Horizontal / Fresh Air= 3230 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box, Outdoor Type
2.10	Airflow = 5000 cfm / TSP = 550 Pa / Cooling Capacity = 21.64 TR / Horizontal / Fresh Air= 1896 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box, Outdoor Type
2.11	Airflow = 4500 cfm / TSP = 500 Pa / Cooling Capacity = 9.68 TR / Horizontal / Fresh Air= 353 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box
2.12	Airflow = 4000 cfm / TSP = 550 Pa / Cooling Capacity = 18.59 TR / Horizontal / Fresh Air= 1518 cfm, 6RD Cooling+2RD Heating Coil, with Mixing Box, Outdoor Type
2.13	Airflow = 3600 cfm / TSP = 1250 Pa / Cooling Capacity = 19.84 TR / Horizontal / Fresh Air= 1802 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box, With HEPA filter inside AHU
2.14	Airflow = 3500 cfm / TSP = 500 Pa / Cooling Capacity = 32.74 TR / Horizontal / Fresh Air= 3500 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box
2.15	Airflow = 3500 cfm / TSP = 500 Pa / Cooling Capacity = 9.11 TR / Horizontal / Fresh Air= 506 cfm, 6RD Cooling Coil+2RD Heating Coil
2.16	OT 3, 4 & 5 , Airflow = 3200 cfm / TSP = 1250 Pa / Cooling Capacity = 9.24 TR / Horizontal / Fresh Air= 630 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box (Fan shall be with N+1 configuration) Space provision for steam Humidifier
2.17	Airflow = 3100 cfm / TSP = 500 Pa / Cooling Capacity = 15.51 TR / Horizontal / Fresh Air= 1595 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box
2.18	Airflow = 3000 cfm / TSP = 550 Pa / Cooling Capacity = 10.65 TR / Horizontal / Fresh Air= 903 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing box, Outdoor type
2.19	OT-10 , Airflow = 3000 cfm / TSP = 1250 Pa / Cooling Capacity = 9.81 TR / Horizontal / Fresh Air= 690 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box (Fan shall be with N+1 configuration) Space provision for steam Humidifier
2.20	OT-6 , Airflow = 3000 cfm / TSP = 1250 Pa / Cooling Capacity = 8.67 TR / Horizontal / Fresh Air= 574 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box (Fan shall be with N+1 configuration) Space provision for steam Humidifier
2.21	Airflow = 2800 cfm / TSP = 550 Pa / Cooling Capacity = 14.99 TR / Horizontal / Fresh Air= 1433 cfm, 8RD Cooling+2RD Heating Coil, with Mixing Box, Outdoor Type
2.22	OT-7 , Airflow = 2800 cfm / TSP = 1250 Pa / Cooling Capacity = 8.32 TR / Horizontal / Fresh Air= 541 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box (Fan shall be with N+1 configuration) Space provision for steam Humidifier
2.23	OT-1 , Airflow = 2600 cfm / TSP = 1250 Pa / Cooling Capacity = 7.95 TR / Horizontal / Fresh Air= 500 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box (Fan shall be with N+1 configuration) Space provision for steam Humidifier
2.24	Cath , Airflow = 2500 cfm / TSP = 1250 Pa / Cooling Capacity = 9.24 TR / Horizontal / Fresh Air= 655 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing box, Outdoor type (Fan shall be with N+1 configuration) Space provision for steam Humidifier
2.25	Airflow = 2500 cfm / TSP = 550 Pa / Cooling Capacity = 8.61 TR / Horizontal / Fresh Air= 725 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box, Outdoor type
2.26	OT-2 , Airflow = 2500 cfm / TSP = 1250 Pa / Cooling Capacity = 7.91 TR / Horizontal / Fresh Air= 500 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box (Fan shall be with N+1 configuration) Space provision for steam Humidifier

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
2.27	Airflow = 2200 cfm / TSP = 550 Pa / Cooling Capacity = 12.15 TR / Horizontal / Fresh Air= 1111 cfm, 8RD Cooling Coil+2RD Heating Coil, with Mixing Box, Outdoor Type
2.28	Airflow = 2100 cfm / TSP = 500 Pa / Cooling Capacity = 11.62 TR / Horizontal / Fresh Air= 997 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box
2.29	Airflow = 1700 cfm / TSP = 500 Pa / Cooling Capacity = 6.97 TR / Horizontal / Fresh Air= 550 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box
2.30	Airflow = 1500 cfm / TSP = 500 Pa / Cooling Capacity = 4.95 TR / Horizontal / Fresh Air= 436 cfm, 6RD Cooling Coil+2RD Heating Coil, with Mixing Box
3	FLOOR MOUNTED AIR HANDLING UNIT (FOR OT with once through system):
	Supply, Installation, Testing and commissioning of factory built floor mounted double skin type Heat recovery unit made with Thermal Break Profile with (0.8mm) pre coated GSS from outside & (1.0mm) Aluminium on inside with PUF Insulation of casing thickness (min. 40 mm) and density (min. 42± 2kg/cum) between them. AHU may be floor mounted & should be of sufficient Tonnage, CFM & static pressure as per requirements. It should comply a minimum of following Eurovent Standards to fulfil the requirements of Energy Efficiency class and performance of the Air Handling Units. i. Casing Leakage Class (-400Pa and +700Pa) - L1 ii. Casing Mechanical Strength - D1 iii. Thermal Bridge - TB2 iv. Thermal Transmittance - T2 and v. Filter Bypass Factor - F9.
	The unit shall be installed using vibration isolators to avoid transfer of vibration to the building. The HRU along with selection software shall be AHRI/ Eurovent certified. The unit shall be smart with controller, HMI as per attached I/O summary and specifications. The unit shall communicate with BMS through BACnet/ IP protocol for control & monitoring.
	The fresh air section shall space provision for Electronic Air Filtration System (MERV-14) & AHU coil mounted UVGI system, TEFC drive IE-3 motor suitable for 415 ± 10% volts, 50Hz, 3 Phase AC supply. All AHUs shall be equipped with VFDs. Fan should be backward curved Airfoil blade Plug Type for supply/exhaust. Fans must be selected for suitable Static Pressure & CFM. Multiple plug fans should be selected with minimum efficiency of 70%., Enthalpy Recovery section with enthalpy recovery wheel, Passive dehumidification section with Passive dehumidification wheel, volume control damper for fresh air duct connection, 8 row deep chilled water cooling coil, 4 row deep DX coil, drain connections, insulated stainless steel (18G) drain pan.
	The exhaust air section shall include HDPE washale MERV-8 pre filter with filtration efficiency of 90% for 10 micron particle size, TEFC drive IE-3 motor suitable for 415 ± 10% volts, 50Hz, 3 Phase AC supply. All AHUs shall be equipped with VFDs. Fan should be backward curved Airfoil blade Plug Type for supply/exhaust. Fans must be selected for suitable Static Pressure & CFM. Multiple plug fans should be selected with minimum efficiency of 70%., Enthalpy Recovery section with enthalpy recovery wheel, Passive dehumidification section with Passive dehumidification wheel, volume control damper for exhaust air duct connection.
	The performance of the HRW and PDHC wheel shall be AHRI/ Eurovent certified and shall have AHRI/ Eurovent stamp.
	Maximum air face velocity across filters/Coils shall be 2m/sec. Velocity & friction factor for Pipe Sizing shall be in conformance to relevant standards
	The enthalpy wheel shall be min. 270 mm thick and shall be capable of recovering atleast 75% latent as well as sensible energy.
	The PDHC wheel shall be able to regenerate on RH differential (from room return air) without any use of external Heat source. The Absolute humidity reduction by this wheel shall be minimum 1.7 Gr/Kg in peak monsoon conditions.

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	The unit shall be designed for giving output of DBT 9 Deg C, & Absolute Humidity 6 Gr/Kg for Summer & Monsoon condition.
	The unit shall be provided with weather proof (IP 67 or better) unit mounted control panel having MPCBs & starters for both fans, both wheels, etc. including all internal wiring and earthing, over load protection, under load protection, sensors, controllers, etc. Only single power cabling, earthing and control cabling shall be provided at control panel from outside.
	The unit shall be provided with potentiometer. The unit shall be provided with BMS premium module for BMS connectivity having the Auto/ manual selection system and HMI. The unit shall operate through BMS in Auto mode and through potentiometer in manual mode. All the internal power and control wiring shall be factory provided. The unit shall have pressure measurement ports at suction and discharge of fan to connect the differential pressure sensor.
	The HRU shall have suitable interlock to switch off the UV lamps whenever someone open the door of HRU. The HRU shall also have suitable interlock to switch on and off the UV lamps & ESP filter as per HRU operation.
	Limit switches with control wiring at fan sections doors to switch off the fans motors when fans sections are opened. Price to include light point, light within the fans sections along with wiring & earthing.
	DDC Panel & Instrument kit to be considered
	Actual static pressures shall be checked by the vendor and consider accordingly and no extra cost shall be paid later in case any change of static pressure required during execution.
	The total static pressure to be considered taking maximum pressure drop of all other components of HRU including filters in full dirty condition.
3.1	<p>OT-8&9, Fresh Air Section = 2800 cfm / TSP = 1250 Pa / Cooling Capacity = 31.25 TR / cooling coil 8RD chld water + 4RD DX coil + 2RD Heating Coil/ Enthalpy Wheel/ PDHC wheel</p> <p>Exhaust Air Section = 2500 cfm / TSP = 55 Pa |/ Enthalpy Wheel/ PDHC wheel Horizontal</p> <p>(Fan shall be with N+1 configuration) Space provision for steam Humidifier</p>
4	HEAT RECOVERY UNIT:
	Supply, Installation, Testing and commissioning of factory fabricated Double skinned construction with Thermal Break Profile with (0.8mm) pre coated GSS from outside & (0.8mm) GSS on inside with PUF Insulation of casing thickness (min. 40 mm) and density (min. 42± 2kg/cum) between them. AHU may be floor mounted & should be of sufficient Tonnage, CFM & static pressure as per requirements. It should comply a minimum of following
	All HRUs shall have fresh and return air sections with dampers, pre-filters, fans and plate type heat-exchange within it. Pressure drop of the heat exchanger should be selected within maximum pressure level of 200Pa. Maximum air face velocity across filters/Plate type heat-exchanger shall be 2m/s. TEFC drive IE-3 motor suitable for 415 ± 10% volts, 50Hz, 3 Phase AC supply. All AHUs shall be equipped with VFDs. Fan should be backward curved Airfoil blade Plug Type for supply/exhaust. Fans must be selected for suitable Static Pressure & CFM. Multiple plug fans should be selected with minimum efficiency of 70%. All HRUs shall be with bag type pre-filters with a class of G4 for exhaust & space provision for ESP filter for supply of the plate type heat exchanger. All units should have diffuser section after fan section to maintain laminarity in the supply
	Suitable Foundation for Floor Mounted HRUs should be considered with anti-vibration pads.

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	<p>HEAT EXCHANGER Specification The Heat Exchanger should consist of specially formed aluminum plates. Its profile has been optimized through extensive testing for thermal efficiency, pressure drop and rigidity. The plates are joined together via an interlocking fold. This means that the material is several times thicker at the air inlet and outlet, makes the exchanger package extremely rigid. The minimum efficiency of the plate heat exchanger should be 50%. The exchanger package is fitted into a casing of connection profiles and side walls. The corners of the exchanger package are sealed into the Aluzinc sheet steel connection profiles with a sealing compound. The side walls made of Aluzinc sheet steel are riveted onto the connection profiles. Standard construction type- The side walls of the casing have a double-folded edge. This facilitates the handling of the exchanger with lifting tools and enables control dampers to be mounted. The side walls of the casing should flat. That creates more space for the exchanger package and thus greater performance. Counter-flow plate heat exchangers for energy recovery, consisting of the exchanger package and the casing. The exchanger package consists of aluminum plates with pressed-in spacers; condensate drainage is possible in every direction, depending on the installation position.</p>
	<p>The plates are connected by a fold, which gives a several fold material thickness at air entry and exit. The corners of the exchanger package are sealed into especially rigid Aluzinc sheet steel connection profiles in the casing with a sealing compound. The side walls of Aluzinc sheet steel are riveted tightly to these extrusions. The suitability of the exchangers for use both in general ventilation technology and in hospitals is certified by independent test institutes.</p> <p>The width of the plate heat exchangers can be selected in steps of 1 mm. In order to simplify transport and very wide exchangers are delivered in 2 parts. Several exchangers with dampers are linked with connecting bolts when installed into the air handling unit. A connecting bolt is installation also supplied. It should have Aluminium plates and aluzinc sheet steel; differential pressure stability: max. 2000 Pa; silicone-free; resistant to 80deg C.</p>
4.1	Airflow Supply = 20000 cfm, / TSP = 550 Pa / Airflow Exhaust = cfm / TSP = 500 Pa/ Heat Recovery Plate type
4.2	Airflow Supply = 17000 cfm / TSP = 550 Pa / Airflow Exhaust = cfm / TSP = 500 Pa/ Heat Recovery Plate type
4.3	Airflow Supply = 15000 cfm / TSP = 550 Pa / Airflow Exhaust = cfm / TSP = 500 Pa/ Heat Recovery Plate type
4.4	Airflow Supply = 13000 cfm / TSP = 550 Pa / Airflow Exhaust = cfm / TSP = 500 Pa/ Heat Recovery Plate type
5	UVGI SYSTEM (AHU MOUNTED):
	<p>Supplying, Installing, Testing and Commissioning of AHU coil mounted UVGI system for maintaining Indoor Air Quality & Deep Coil Cleaning. The system shall include UV modules with different lamp sizes from 450 mm to 900 mm to cater all type AHU Coil sizes .UVGI System shall be suitable for a UV dose of greater than 5,00 µJ/cm² in a single pass to achieve kill rate at least 99% (log 2) of virus/bacteria susceptible to this dose, the uv system shall be with control panel with BMS connectivity. UVGI system supplied must be in strict conformity with the specifications.</p>
5.1	AHU's 1000 CFM to 5000 CFM
5.2	AHU's 5001 CFM to 8000 CFM
5.3	AHU's 8001 CFM to 13000 CFM
5.4	AHU's 13001 CFM to 18000 CFM
6	UVGI SYSTEM (DUCT MOUNTED):

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	Supplying, Installing, Testing and Commissioning of Duct/Plenum mounted UVGI system for maintaining Indoor Air Quality & Air disinfection. To limit the spread of air borne infections in air conditioned space. The system shall include UV modules with different lamp sizes from 450 mm to 900 mm to cater all type duct/plenum sizes .UVGI System shall be suitable for a UV dose of greater than 3,000 µJ/cm ² or Lamp shall be of high intensity type 800mA. The MOC of each lamp should be High Purity Fused Quartz or as per OEM standard, the uv system shall be with control panel with BMS connectivity. UVGI system supplied must be in strict conformity with the specifications.
6.1	AHU's 1000 CFM to 5000 CFM
6.2	AHU's 5001 CFM to 8000 CFM
6.3	AHU's 8001 CFM to 13000 CFM
7	FAN COIL UNITS:
	Supply, installation, testing and commissioning of ceiling mounted type horizontal fan coil units complete with finned 3RD cooling coil, maximum water velocity 1.8 m/s and air velocity 155 mpm, fan section consist of two lightweight aluminum impellers of forward curved type, both statically and dynamically balanced, along with properly designed GI sheet casings. The two impellers shall be directly mounted on to a double shaft, single phase multiple winding motor capable of running at three speeds, drain pans, shall be cleanable type 15mm thick with 90% efficiency down to 10 micron of dry cleanable synthetic type, thermostat, control wiring and other controls as per specifications and drawings.
7.1	2.0 TR nominal capacity - 800 CFM
7.2	1.5 TR nominal capacity - 600 CFM
8	ELECTROSTATIC FILTER:
	Supplying, Installing, Testing and Commissioning of filter section central air cleaner a hybrid air purification system that improves the indoor air quality through reducing harmful pollutants like particulate matter (PM _x), PM 2.5, allergens, pollen, smoke, bacteria, pathogens based on Electrostatic precipitation technology. Other forms of air filtration systems such as charged media filters, dielectric media filters, or ionizers (which do not have second stage collector plates) shall not be acceptable. It should be a monobloc structured unit specifically designed for integration in Return Air path of the AHU, to centrally capture the pollutants. It should be equivalent to MERV14 efficiency @ 2000 cfm with low pressure drop of not more than 65Pa @ 492fpm (certification for the same to be provided). It should be UL certified within built provision to connect to BMS.
	The product has to be certified as a green product by any of the Green Building councils across the world. The central air cleaner units must have a valid ANSI/ASHRAE 52.2 test report to verify filtration efficiency. The unit must have factory test report to ensure that it meets the following safety and environmental criteria with reference to ES164468, UL 867 and DA 6.2.1. Ozone level of units provided must be within the acceptable limit of 0.05ppm. The units shall have local LEDs at each individual unit to indicate when the units are up for wash/malfunctioning
8.1	Single module (1000 cfm)
8.2	Double module (2000 cfm)
9	PRECISION A/C UNITS:

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	Supplying, Installing, Testing and Commissioning of DIRECT EXPANSION MICROPROCESSOR BASED PRECISION A/C UNITS as per the specifications complete with All four sides doubled skin sandwich panels with A1 class insulation, air cooled condenser with step less variable speed fans for winter operation, with minimum one BLDC Variable Speed scroll compressor with crankcase heater, evaporator coil with hydrophilic coating, Electronically commutated brushless motor Backward curved Plug fan, Electronic Expansion Valve with pressure transducers to display suction, discharge and superheat on microprocessor panel, Refrigerant shall be environment friendly refrigerant R410A, hot gas reheat coil with modulating control instead of electric heaters, variable capacity auto-modulating humidifier (efficiency minimum 0.75kW/Kg/hr), stainless steel drain pan, oil separator, Liquid Receiver, Pressure Relief Safety Valve, Liquid Line Solenoid Valve and vibration isolator. Motor shall be suitable for 415 + 10% volts, 50 cycles, 3 phase AC supply and external static pressure shall be 20 Pa. Outdoor unit motor protection should be with IP-54 protection and should be weather proof, it should have Fan Speed Controller to modulate the Fan Speed by sensing the Condensing Pressure for Low Ambient Operation. . Auto sequencing of the unit for equal run time should be integral part of the micro-processor .Clogged Filter alarm, Water leakage detector as required .The unit shall be able to operate up to ambient of 43 deg C. Unit shall have Touch Screen Display.
	Each unit shall be BMS compatible and shall have inbuilt software to facilitate BMS connectivity through RS485 Modbus Protocol and Ethernet with Modbus Protocol and HTTP Protocol
9.1	5.5 TR / 2800 cfm (Actual capacity at 24 Deg C /50% RH Return Air Condition & 32.2 Deg C Outside Ambient Conditions) (1W+1S)
10	CONDENSING UNITS FOR DX COIL OF OT AHU
	Supply, Transportation, Installation, Testing and Commissioning of the following OUTDOOR CONDENSING UNITS-INVERTER type suitable to operate upto 35°C ambient temperature with minimum one variable speed inverter scroll compressor. Matching air cooled condenser with copper tubes and aluminium fins duly covered by anti-corrosion and hydrophilic resin film. Scroll compressors suitable for operation with R-410A.. Unit with all necessary safety devices like high/low pressure cut-outs, fan motor thermal overload protector, over current/low current safety, fuses etc. Suitable for operation on 80V~415V~3Ph~50Hz A.C. supply. Oil separator and Accumulator to be provided for inverter compressors and with copper condensing units.
10.1	8.5 TR actual capacity at 35 deg. C ambient
11	AIR COOLED INVERTER HI WALL UNIT:
	Supply, Installation, Testing and Commissioning of inverter air cooled Split airconditioning unit of BEE 5 star rating consist of outdoor unit, indoor unit wireless remote control the outdoor unit shall comprise of rotary / reciprocating compressor, referigent should be CFC free, air-cooled condenser, fan, fan motor with corded remote controller, electrical accessories & suitable stand of MS angle iron painted with anti-rusted treatment for installation of outdoor unit the indoor unit shall be decorative Hi-wall type complete with cooling coil, drain pan washable pre filter first charge of referigent complete with suitable capacity voltage stabilizer etc as reqd for voltage range of 100V~300V. Unit shall be supplied fully refrigerant charged plus additional top up of refrigerant to suit piping length. Unit shall be suitable for working under long length of refrigerant piping up to 20 meter minium. Refrigerant piping (Pair) up to 20 meter price to be included. The condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air.
11.1	2.0 TR Capacity
12	STEAM HUMIDIFIRE:
	Supply, Installation, Testing & Commissioning of Immersed resistive heater type of humidification system
	The humidifier system shall have the following:
	Linear Stainless Steam Distributor made of SS 304 material supported by a fastening bracket.

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	Steam Hose Pipe of a length of 4m with a Operating temperature range of -25°C to 105°C. Hose should be made of thermoplastic rubber with galvanized steel helix and polyester yarn reinforcement.
	Condensate Air Water Pipe of a length of 4m.
	Hot water drain hose of dia 40 mm & 1m long, Operating Temperature range should be -30°C to +110°C. Pipe should be of the following composition- heat-resistant smooth black EPDM rubber substrate. Reinforced with heat-resistant synthetic fabric. Smooth, resistant outer covering. 1 m long
	Duct Temperature / Humidity Sensor
	Inlet Water Pipe at the Supply point of 1.5 m.
	The steam generator shall also have twin sensing electrodes for detection of water foaming and high limit water level;
	Antifoam algorithm (AFS) to prevent irregular operation due to the formation of foam inside the cylinder;
	Each element shall have 1 PTC to detect and protect against overheating;
	Electric resistances made in titanium with low thermal resistance for fast response, stability of production and safety against overheating;
	Must have a Graphic touch display 4.3"
	Water level sensor for the precise control of the water level on the entire conductivity range 0...1500µS/cm, without any change or additional board
	Humidifier shall be suitable for RO / DM Water or all types of water.
	Intelligent microprocessor controller with algorithm that automatically adapts operation to the water quality
	Steam capacity shall be continuously controlled in the range 0..100% of the rated production;
	Humidifier shall have built-in power transformer, no needs of neutral line on power supply or additional external transformer
	Embedded conductivity meter for the automatic management of the dilution drains and subsequent fills according to the supply water quality
	SSR's (solid-state relays) for precise modulation of the steam production by dosing the power fed to the water
	Humidifier should be of IP20 Rating
	RS485 serial port ready to communicate on Modbus, Bacnet protocol for supervisory system. Without any additional devices
	Thermal shock feature, removing lime scale from the heating elements, extends the cleaning intervals and makes maintenance quicker
	Metallic housing with cover removable to allow full front access for easy maintenance
	The humidifier shall limit the steam production based on a proportional hi-limit probe that is self-adjusting according to AHU/duct air flow
	Electrical section separated by a division wall and including the power circuitry and the control components, manufactured according to state-of-the-art norms
	Pre-heating to keep the water warm in order to reduce the time to production (user-editable pre-heating set point
12.1	Humidification Load - 6kg/hr
13	ROOM PRESSURE GAUGES:
	Supply, installation, testing & commissioning of Battery operated Digital type differential pressure gauges to observe the room pressure. Range: 0 to 60 Pa
14	AIR CURTAIN WITH DIRECT DRIVEN FANS:
	Supply, installation, testing and commissioning of Air curtain units constructed with Artistically designed curvaceous body constructed in aluminium extruded powder coated sections with powder coated sheet metal base and mounting plates. Motors constructed in aluminium body to enable rapid cooling, with copper winding, bearing based motors made in

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	CRNO core to run continuously for 24X7 operation, with thermal overload protection. Dynamically balanced centrifugal Blowers made in virgin plastic, with aerodynamically designed fins to deliver high volume of air., the suction grills should be made in plastic. Air Curtain should have dual speed with max. Velocity at Nozzle between 19-21 m/s. Air curtain should be coupled with the door, with a automatic magnetic limit switch, to synchronize working of air curtain with opening of the door.
14.1	Air curtain suitable for 2200 mm to 2500 mm width Door and 10 ft height with max velocity at nozzle shall be 23 m/s. The air curtain shall be with top suction guide with 2800 RPM speed. The Front Chassis shall be of aluminium profile, main and back plate shall be of metal power coated. Voltage input shall be 220 -240 Volts single phase with squirrel cage induction motor and shall suitable for horizontal / vertical mounting.
B	WATER PIPING:
1	Supplying, laying/ fixing, testing and commissioning of following nominal sizes of chilled water piping plumbing inside the building (with necessary clamps, vibration isolators and fittings but excluding valves, strainers, gauges etc.) duly insulated with fire retardant quality expanded polystyrene moulded pipe section of density 20 kg/cu.m after a thick coat of cold setting adhesive (CPRX compound) wrapping with 500g polythene faced hessain and finally applying 0.63mm aluminium sheet cladding complete with type3 , grade 1 roofing felt strip(as per IS:1322 as amended up to date) at joints repairing of damage to building etc. as per specifications and as required complete in all respect. The pipes shall be joined using Grooved Fittings conforming to ASTM Grade A-536. The Grooved Couplings shall be Standard OGS Groove from 20 NB - 12". Installation Ready Coupling shall be used from 2"-12" and shall be conform to AGS Grooving from 14" & above
	Note:-The Pipes of sizes 150mm & below shall be M.S. 'C' class as per IS : 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes upto 350 mm dia. and from minimum 7mm thick MS sheet for pipes of 400 mm dia and above. The pipes shall be joined using Grooved Coupling
1.1	200 mm dia MS pipes (75 mm insulation)
1.2	150 mm dia MS pipes (75 mm insulation)
1.3	125 mm dia MS pipes (50 mm insulation)
1.4	100 mm dia MS pipes (50 mm insulation)
1.5	80 mm dia MS pipes (50 mm insulation)
1.6	65 mm dia MS pipes (50 mm insulation)
1.7	50 mm dia MS pipes (50 mm insulation)
1.8	40 mm dia MS pipes (50 mm insulation)
1.9	32 mm dia MS pipes (50 mm insulation)
1.10	25 mm dia MS pipes (50 mm insulation)
1.11	20 mm dia MS pipes (50 mm insulation)
2	Condensate Drain Piping:
	Providing and fixing G.I. pipes complete with G.I. fittings and clamps, i/c cutting and making good the walls etc for condensate drain.
2.1	40 mm dia
3	Condensate Drain Piping Insulation:

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	Supplying, laying/ fixing of following thickness insulation with fire retardant quality expanded polystyrene moulded pipe section of density 20 kg/cu.m after a thick coat of cold setting adhesive (CPRX compound) wrapping with 500g polythene faced hessain and finally applying 0.63mm aluminum sheet cladding complete with type3 , grade 1 roofing felt strip(as per IS:1322 as amended up to date) at joints repairing etc. as per specifications and as required complete in all respect.
3.1	50 mm
4	Insulated Valves:
	Supplying, fixing, testing and commissioning of following valves, strainers, gauges in the chilled water plumbing duly insulated to the same specifications as the connected piping and adequately supported as per specifications.
4.1	BUTTERFLY VALVE (MANUAL) with C I body SS Disc, Nitrile Rubber Seal & O- Ring PN 16 pressure rating for chilled water/ hot eater circulation as specified.
4.1.1	100 mm dia
4.1.2	80 mm dia
4.1.3	65 mm dia
4.1.4	50 mm dia
4.1.5	40 mm dia
4.1.6	32 mm dia
4.1.7	25 mm dia
4.2	Y - STRAINER of Ductile CI Body flanged ends with stainless steel strainer for chilled/ hot water circulation including insulation as specified.
4.2.1	100 mm dia
4.2.2	80 mm dia
4.2.3	65 mm dia
4.2.4	50 mm dia
4.2.5	40 mm dia
4.2.6	32 mm dia
4.2.7	25 mm dia
4.3	PICB Valve
	Supplying, fixing, testing and commissioning Electronic, self-balancing, pressure independent type dynamic balancing valve with integrated 2 way modulating control valve in a single body. The actuator shall be capable of accepting upto 10V DC and upto 20 mA electric signal and shall provide similar transduced feedback output to control system. Maximum close off pressure shall not be less than 6 Bar for upto 50 mm valves and 7 Bar for 65 mm & above. Valves should have pressure rating of 25 Bar minimum.
4.3.1	100 mm dia
4.3.2	80 mm dia
4.3.3	65 mm dia
4.3.4	50 mm dia
4.3.5	40 mm dia
4.3.6	32 mm dia
4.3.7	25 mm dia
4.4	Providing and fixing in position the industrial type pressure gauges with gun metal / brass valves complete as required.
4.5	
4.6	Providing & fixing in position the mercury in glass industrial type thermometers.
	Thermostat

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
4.7	Providing and fixing of thermostat for dual mode both heating and cooling along with sensor and control cabling. (BMS compatible) Semi Flush-mount room temperature controllers with LCD display, 24V AC Model RDU340/ equivalent
	Automatic air vent
4.8	Supply, installation, testing and commissioning of 10mmdia. Automatic air vent in brass construction complete with nipples, union etc. as required at all high points in the pipe lines. The valve shall be such as to have non-return valve as integral part of the vent.
5	Groove Fittings:
	Providing, laying, jointing, testing and commissioning of following sizes of Grooved Couplings & Grooved Fittings in pipes for Chilled Water and Condenser Water Lines including all accessories. The Grooved Fittings shall be supplied by manufacturer of grooved Couplings The Couplings should not need any torque to tighten upto 12". Tongue & Recess Couplings are not allowed. Angle Pad Design Grooved Couplings are allowed. The Minimum working pressure rating should be above 400 psi for these sizes upto 12" The Couplings from 14" and above should need AGS Groove Welding is not allowed to join pipes
5.1	Grooved Couplings
5.1.1	200 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.2	150 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.3	125 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.4	100 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.5	80 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.6	65 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.7	50 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.8	40 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.9	32 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.10	25 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.11	20 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.2	Grooved Elbows
5.2.1	200 NB
5.2.2	150 NB
5.2.3	125 NB
5.2.4	100 NB
5.2.5	80 NB
5.2.6	65 NB
5.2.7	50 NB
5.2.8	40 NB
5.2.9	32 NB
5.2.10	25 NB

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
5.2.11	20 NB
5.3	Grooved Reducers
5.3.1	200 NB
5.3.2	150 NB
5.3.3	125 NB
5.3.4	100 NB
5.3.5	80 NB
5.3.6	65 NB
5.3.7	50 NB
5.3.8	40 NB
5.3.9	32 NB
5.3.10	25 NB
5.3.11	20 NB
5.4	Grooved Equal Tees
5.4.1	200 NB
5.4.2	150 NB
5.4.3	125 NB
5.4.4	100 NB
5.4.5	80 NB
5.4.6	65 NB
5.4.7	50 NB
5.4.8	40 NB
5.4.9	32 NB
5.4.10	25 NB
5.4.11	20 NB
5.5	Grooved Unequal Tees
5.5.1	200 NB
5.5.2	150 NB
5.5.3	125 NB
5.5.4	100 NB
5.5.5	80 NB
5.5.6	65 NB
5.5.7	50 NB
5.5.8	40 NB
5.5.9	32 NB
5.5.10	25 NB
5.5.11	20 NB
5.6	Grooved Flange Adapters
5.6.1	100 NB
5.6.2	80 NB
5.6.3	65 NB
5.6.4	50 NB
5.6.5	40 NB
5.6.6	32 NB
5.6.7	25 NB
6	Providing, laying, jointing, testing and commissioning Three Grooved Flexible Coupling to be installed as expansion joints in each location for Chilled water piping located at Pump inlet & exit, AHU inlet & exit and at chiller inlet & exit ahu. Complete with all fittings, necessary hardware and gaskets etc., with insulation of following sizes:
6.1	100 mm dia
6.2	80 mm dia

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
6.3	65 mm dia
6.4	50 mm dia
6.5	40 mm dia
6.6	32 mm dia
6.7	25 mm dia
7	FCU Link:
	Supply, Installation, Testing, & Commissioning Factory assembled fully insulated DZR Brass FCU LINK consists of:- 3 nos. full port isolating valves in supply, return & bypass, Fixed Orifice Plate Measuring Station, Strainer with stainless Steel Mesh, Drain Cock, Two Pressure / Temperature measuring knobs, Pressure Independent control valve (PICV/PID) with modulating actuator OR ON/OFF actuator , Stainless Steel Flexible Connector 300mm (2 pieces), Thermal insulating kit made of high Density Black EPP. Pressure rating (PN-20)
7.1	25 mm dia
7.2	20 mm dia
C	MECHANICAL VENTILATION SYSTEM:
1	FANS FOR SMOKE EXHAUST IN CASE OF FIRE
	Supply, Installation, Testing & Commissioning of long casing(GSS) Vane/Tube Axial flow type fans complete with aluminum alloy blades with aerofoil design, bird screen, flexible connection & gravity louvers at outlet. Motor shall be of 415 + 10% volts, 50 Hz. Sound level at 3mt distance from fan outlet shall not be more than 90 db(A) (Room Condition). Capacity shall be as follows & as per detailed technical specification: Fans should be AMCA certified. Manufacturer shall submit "Certificate of conformity for 250 deg for 2 hours operation as per EN12101-3: 2002 issued by Internationally recognized Independent Fire Laboratory should be submitted along with type test report. The Type test report should clearly indicate the make of motor used during the testing and the same make/model of motor should be supplied by the fan manufacture at the site." RPM Should Not exceed 1450. However lower cfm upto 5000 CFM can be provided at 2850 RPM. Outlet velocity shuld not exceed 16 m/s
1.1	44000 cfm at 40 mm static pressure
1.2	22500 cfm at 40 mm static pressure
1.3	17500 cfm at 40 mm static pressure
1.4	13200 cfm at 40 mm static pressure
1.5	11500 cfm at 40 mm static pressure
1.6	11000 cfm at 40 mm static pressure
1.7	10000 cfm at 40 mm static pressure
1.8	9500 cfm at 40 mm static pressure
1.9	9300 cfm at 40 mm static pressure
1.10	8500 cfm at 40 mm static pressure
1.11	8000 cfm at 40 mm static pressure
1.12	7500 cfm at 40 mm static pressure
1.13	7000 cfm at 40 mm static pressure
1.14	5500 cfm at 40 mm static pressure
1.15	5000 cfm at 40 mm static pressure
1.16	3500 cfm at 40 mm static pressure
1.17	3200 cfm at 40 mm static pressure
1.18	3000 cfm at 40 mm static pressure
2	FANS FOR SUPPLY AIR IN CASE OF FIRE

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	Supply, Installation, Testing & Commissioning of long casing(GSS) Vane/Tube Axial flow type fans complete with aluminum alloy blades with aerofoil design, bird screen, flexible connection & gravity louvers at outlet. Motor shall be of 415 + 10% volts, 50 Hz. Sound level at 3mt distance from fan outlet shall not be more than 90 db(A) (Room Condition). Capacity shall be as follows & as per detailed technical specification: Fans should be AMCA certified. RPM Should Not exceed 1450. However lower cfm upto 5000 CFM can be provided at 2850 RPM. Outlet velocity shuld not exceed 16 m/s
2.1	11500 cfm at 40 mm static pressure
2.2	11000 cfm at 40 mm static pressure
2.3	10700 cfm at 40 mm static pressure
2.4	10000 cfm at 40 mm static pressure
2.5	9500 cfm at 40 mm static pressure
2.6	9000 cfm at 40 mm static pressure
2.7	8500 cfm at 40 mm static pressure
2.8	8000 cfm at 40 mm static pressure
2.9	7500 cfm at 40 mm static pressure
2.10	7000 cfm at 40 mm static pressure
2.11	6000 cfm at 40 mm static pressure
2.12	5500 cfm at 40 mm static pressure
2.13	5000 cfm at 40 mm static pressure
2.14	4750 cfm at 40 mm static pressure
2.15	4500 cfm at 40 mm static pressure
2.16	3500 cfm at 40 mm static pressure
2.17	3200 cfm at 40 mm static pressure
2.18	3000 cfm at 40 mm static pressure
2.19	2500 cfm at 40 mm static pressure
3	TUBE AXIAL FLOW FANS (Lift lobby, Lift well & Staircase Pressurization):
	Supply, Installation, Testing & Commissioning of long casing(GSS) Vane/Tube Axial flow type supply air fans complete with aluminum alloy blades with aerofoil design, bird screen, flexible connection & gravity louvers at outlet. Motor shall be of 415 + 10% volts, 50 Hz. Sound level at 3mt distance from fan outlet shall not be more than 90db(A) (Room Condition). Capacity shall be as follows & as per detailed technical specification: Fans should be AMCA certified." RPM Should Not exceed 1450. However lower cfm upto 5000 CFM can be provided at 2850 RPM. Outlet velocity shuld not exceed 15 m/s
3.1	5200 cfm capacity with 25 mm static pressure for lift well pressurization
3.2	21000 cfm capacity with 30 mm static pressure for staircase pressurization
3.3	17000 cfm capacity with 30 mm static pressure for staircase pressurization
3.4	15000 cfm capacity with 30 mm static pressure for staircase pressurization
3.5	9000 cfm capacity with 30 mm static pressure for lift lobby pressurization
3.6	7000 cfm capacity with 30 mm static pressure for lift lobby pressurization
4	CENTRIFUGAL FAN (With Cabinet)
	Supply, installation, testing and commissioning of DIDW centrifugal fan, GI construction. The fan shall be suitable for V belt drive arrangement & in bare shaft construction. The fan impeller shall have backward curved blades suitable for handling air. The centrifugal fan motor shall be suitable for single speed TEFC squirrel cage induction motor suitable for 415 415 volts \pm 10%, 50Hz \pm 5 %, three phase AC power supply motor with class "H" insulation, Fire resistant V belt drive set comprising of fan & motor pullys & one set of belts, slide rails, MS / GI belt protection, fire rated convass connection at outlet side, multilouvers damper at outlet side in GI construction with casing in 16 G & louvers in 18 G construction, foundation bolts, common base frame in standard MS construction, anti-vibration mountings arrangement. The fan capacity shall be as follows:-
4.1	13500 CFM at 40 mm static pressure

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
4.2	6200 CFM at 40 mm static pressure
4.3	3900 CFM at 40 mm static pressure
4.4	3500 CFM at 40 mm static pressure
4.5	2500 CFM at 40 mm static pressure
4.6	2300 CFM at 40 mm static pressure
4.7	1700 CFM at 40 mm static pressure
4.8	1600 CFM at 40 mm static pressure
4.9	1400 CFM at 40 mm static pressure
4.10	1000 CFM at 40 mm static pressure
4.11	950 CFM at 40 mm static pressure
4.12	900 CFM at 40 mm static pressure
4.13	300 CFM at 90 mm static pressure with hepa filter
5 PROPELLER FAN	
	Supply, Installation, Testing and commissioning etc as required, wall mounted propeller type exhaust fans shall be of Axial Flow type with light weight type PVC/ aluminum impellers with aerofoil contours for high efficiency and low noise. The fan shall be supplied complete with wooden frames and gravity louvers with a suitable Squirrel cage induction motor. Fan should be AMCA certified.
5.1	450 mm dia
5.2	230 mm dia
5.3	150 mm dia
6 INLINE FAN SINGLE PHASE	
	Supply, Installation, Testing and commissioning of exhaust air fan section suitable for Inline mounting comprising of forward curved centrifugal blower complete with external rotor induction motor / Induction earthing, canvas connection all compete as required, suitable for single phase, 230 volts, 50Hz AC. supply as per specifications of following capacities: Fan should be AMCA certified. Noise level should not exceed 65dB(A)at 3 meter in room condition.
6.1	800 cfm at 25 mm static pressure
6.2	500 cfm at 25 mm static pressure
6.3	300 cfm at 25 mm static pressure
7 INLINE FAN THREE PHASE	
	Supply, Installation, Testing and commissioning of exhaust air fan section suitable for Inline mounting comprising of SISW/DIDW (CABINATE) complete with external rotor induction motor / Induction 3 phase motor, earthing, canvas connection all compete as required, suitable for three phase, 415volts, 50Hz AC. supply as per specifications of following capacities: Fan should be AMCA certified. Noise level should not exceed 70dB(A)at 3 meter in room condition.
7.1	3200 cfm at 30 mm static pressure
7.2	2500 cfm at 30 mm static pressure
7.3	1800 cfm at 30 mm static pressure
8 DRY SCRUBBER:	
	Supply, Installation, Testing and Commissioning of double skin type dry type scrubber (packaged type) comprising of following as per the specifications :
	Casing of scrubber shall be in double skin construction. Inner skin shall be constructed out of 24 gauge plain GS sheet & outer skin in 24 gauge pre-plasticized GS sheet sandwiched between 50mm thick injected PU foam insulation of density not less than 40 Kg /CuM and complete with inspection doors including control wiring as required. Scrubber shall have access for all parts.

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	Fan section complete with backward curved DIDW type centrifugal fan/s, TEFC squirrel cage induction motor suitable to operate on 415+10%V, 50Hz, 3 phase AC power supply and belt drive package. Centrifugal fans shall be coated with epoxy paint as specified. Fan outlet velocity shall not be more than 2000 FPM (10.16 MPS)
	The Electrostatic section shall be 90-95% in single pass as per DOP test method. Electrostatic Precipitator should be able to charge particles from 0.01 micron to 10 micron through solid state power supply. Collector cell shall be of permanent type and slide out facility for easy removal for cleaning. Operating voltage shall be 220+6 % volts,50 Hz/ 1Ph, power consumption shall not exceeding 50 watts per unit upto 7500 Cfm. System should be fitted with interlock switch for safety. Velocity across the air cleaner shall not be more than 500 FPM. Scrubber shall be provided with pre-filters as required.
8.1	19500 cfm at 50 mm static pressure for Kitchen Exhaust
9	AIRWASHER:
	Supplying, Installing, Testing and Commissioning of CELDEK FILL package type air cooling unit with minimum 90% saturation efficiency. Air cooling unit shall be factory assembled and complete with double skin casing 0.8mm Inner / outer pre-coated GI sheets, DIDW forward curved fans with TEFC, sq. cage, 1440 induction motors(IE-2) with IP-55 Protection suitable for operation on 415 ± 10% voltage, 50 Hz A/c 3 phase, drive package including multi sheave pulleys and belts for fans and motors, 1.2mm thick tank & pad section in SS Construction, vibration isolators, HDPE pre-filters, 200 mm thick CELDEK FILL, Water Circulation Pump (1W+1S), internal PVC piping, valves and fittings with built in 4-bend PVC eliminator. The Unit shall be following capacities
9.1	15700 cfm at 50 mm static pressure for Kitchen supply
9.2	8900 cfm at 50 mm static pressure for Laundry supply
	SUB TOTAL (C) CARRIED OVER TO SUMMARY
D	DUCTING AND GRILLES
1	Ducting
	Supply, installation, balancing and commissioning of factory fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following gauges:- Note: Fabrication and jointing of duct shall be as per IS standard and hanging shall be as per SMACNA.
1.1	Thickness 0.63 mm sheet
1.2	Thickness 0.80 mm sheet
1.3	Thickness 1.00 mm sheet
1.4	Thickness 1.25 mm sheet
2	Supply, installation, balancing and commissioning of Site fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following gauges:-
2.1	Thickness 0.63 mm sheet
2.2	Thickness 0.80 mm sheet
2.3	Thickness 1.00 mm sheet
2.4	Thickness 1.25 mm sheet

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
3	Supply, installation, testing and commissioning of GI volume control duct damper complete with neoprene rubber gaskets, nuts, bolts, screws linkages, flanges etc., as per specifications.
4	Supplying & fixing of powder coated extruded aluminium Supply Air Grills/ exhaust with aluminium volume control dampers as per specifications.
5	Supplying & fixing of powder coated extruded aluminium Supply/Return Air Grills with louvers but without volume control dampers complete as required.
6	Supplying, fixing testing commissioning of supply air diffusers of powder coated aluminium with aluminium volume control dampers with anti-smudge ring & removable core.
7	Supplying, fixing testing commissioning of Return air diffusers of powder coated aluminium without volume control dampers with anti-smudge ring & removable core.
8	Supplying, Fixing, testing and commissioning of fire dampers in supply air duct/main branch and return air path as and where required of required sizes i/c control wiring, the damper shall be motorized and spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored. The spring return action shall be inbuilt mechanism and not externally mounted. The damper shall also be closed in the event of fire signal complete as required and as per specifications.
8.1	Fire damper
8.2	Actuator
9	AC Ducting (PIR-Pre-Insulated) Internal (Running in AC area) Supply Installation testing Commissioning of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel/Board should be CFC/HCFC Free Green Pro & Griha Certified. Thickness is 20mm , Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, base material is Impermeable to moisture and Insoluble, Certified Anti Rodent type material. Can withstand 1500 pa pressure without any deformation and change in insulation, chemical or physical characteristics. The Aluminium Foil shall be 80µ outer side & chequered aluminium thick and provided on inner sides of Panel and the foil shall be embossed from outside and smooth from inside. The fire and smoke classification shall comply to Class "O" of BS 476 part 6 & 7 & Class A ASTM E 84 respectively. Toxicity Index shall not exceed 6. Along with all standard accessories as per manufacturer Standard including profiles, jointers, Adhesives, Sealants & Aluminium tapes The duct Installation shall be Confirming to installation norms of DW-144 and other relevant specifications and standards mentioned in the detailed specifications for Internal Duct Shall be hang through wire rope.
10	AC Ducting (PIR-Pre-Insulated) Internal (Running in Non-AC area)

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	Supply Installation testing Commissioning of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel/Board should be CFC/HCFC Free Green Pro & Griha Certified. Thickness is 30mm , Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, base material is Impermeable to moisture and Insoluble, Certified Anti Rodent type material. Can withstand 1500 pa pressure without any deformation and change in insulation, chemical or physical characteristics. The Aluminium Foil shall be 80µ inner side & 80 micron Upper side , the foil shall be embossed from both the sides. The fire and smoke classification shall comply to Class "O" of BS 476 part 6 & 7 & Class A ASTM E 84 respectively. Toxicity Index shall not exceed 6. Along with all standard accessories as per manufacturer Standard including profiles, jointers, Adhesives, Sealants & Aluminium tapes The duct Installation shall be Confirming to installation norms of DW-144 and other relevant specifications and standards mentioned in the detailed specifications for external/ shaft Duct Shall be hang with Rigid Supports. i.e threaded rod with MS angle.
11	AC Ducting (PIR-Pre-Insulated) Internal (Running in Shaft or On Terrace) Supply Installation testing Commissioning of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel/Board should be CFC/HCFC Free Green Pro & Griha Certified. Thickness is 30mm , Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, base material is Impermeable to moisture and Insoluble, Certified Anti Rodent type material. Can withstand 1500 pa pressure without any deformation and change in insulation, chemical or physical characteristics. The Aluminium Foil shall be 80µ inner side & 200 micron Upper side , the foil shall be embossed from both the sides. The fire and smoke classification shall comply to Class "O" of BS 476 part 6 & 7 & Class A ASTM E 84 respectively. Toxicity Index shall not exceed 6. Along with all standard accessories as per manufacturer Standard including profiles, jointers, Adhesives, Sealants & Aluminium tapes The duct Installation shall be Confirming to installation norms of DW-144 and other relevant specifications and standards mentioned in the detailed specifications for external/ shaft Duct Shall be hang with Rigid Supports. i.e threaded rod with MS angle.Weather proof Lag coating shall be applied
12	AHU Room Acoustic Lining Providing and fixing of acoustic lining on wall and ceiling of AHU rooms with 25mm thick Rigid Board of Glass wool one side aluminum faced and other side black glass cloth lamination, density 70 to 80 kg/cu.m
13	VAV Boxes Supply, installing, testing and commissioning of PRESSURE INDEPENDENT VARIABLE AIR VOLUME Terminal units, suitable for installation in horizontal ducts. The casing shall be made of minimum 0.8mm GSS internally lined with engineered polymer foam insulation .VAV box should be certified by AHRI 880/ASHRAE 130. This shall include all accessories such as Factory Fitted Transformer, Hanger Brackets, single / multileaf damper (with equal % characteristics) etc. actuators, control cabling , digital display Thermostat , and any other ancillary requirement for the functioning of the units. The VAVs shall be suitable for Bacnet Output and factory calibrated for air capacities.
	VAV boxes shall be suitable for following air flow capacities.
13.1	100-3000 CFM
	Note :
	Quoted price shall include the following:
	a. Cooling / heating thermostat with ON/OFF control
	b. Differential pressure sensor
	c. 24 Volt power supply unit for each VAV box.
14	VARIABLE FREQUENCY DRIVES (VFD)

SCHEDULE OF ITEMS FOR HVAC WORKS (Hospital Building)	
S. No.	Description of item
	Supply, installing, testing and commissioning of HVAC dedicated VFDs suitable for the following AHU fan motor capacity (The integration of the VFD with AHU is included in this item) with IP 21 The VFD must be designed specifically for the HVAC Application market and shall be a low Harmonic solution contained within VFD, not requiring any external hardware (like filters/ transformers) and not require any additional wiring(i.e. 3 wire in 3 wire out). This shall be achieved using Active rectifier topology based VFD with IGBTs in both converter & inverters along with DC bus capacitors. VFDs without DC bus capacitors are not acceptable
	Built-in dual DC chokes and inbuilt active harmonic filters to control TDHi less than 5 % at all loads at equipment/VFD level only.
	Built-in EMC class-C2, Functional safety STO (SIL3 – PLe), Conformal coated PCB suitable for 3C2 & 3S2 environments and this product shall comply to CE, UL, CUL, Eco Design, Low voltage directive, ROHS, WEEE, RCM, EAC standards.
	Two-feedback PID (Proportional integrated derivative) controller having capability to simultaneously accept 2 feedback signals from temperature sensors for process optimization and accordingly regulate the speed of the AHUs.
	VFD shall deliver >96% efficiency, Unity total power factor (PFtotal=1), shall able to deliver full voltage to motor when needed even in low line voltage conditions and shall reduce electrical network losses and improve transformer utilization and should be generator friendly.
	The VFD shall be compatible with BMS through MODBUS/BACNET
14.1	VFD's for AHU's feeding VAV Boxes and to be controlled on feedback from Differential pressure switch's/ Differential pressure Sensors to modulate AHU fan speed as per different rooms temperature/RH requirement.
14.1.1	4 KW
14.1.2	2.2 KW
14.2	VFD's for AHU's feeding directly through ducts without VAV Boxes and to be controlled on feedback from temperature/ RH sensors to modulate AHU fan speed as per different rooms temperature/RH requirement. (Price shall include T+RH sensor and control wiring)
14.2.1	4 KW
14.2.2	1.5 KW
14.3	VFD's for AHU's feeding directly through ducts and no control feedback required. The VFD's are implemented for synchronisation of AHU motor and Fan.
14.3.1	4 KW
14.3.2	2.2 KW
14.3.3	1.5 KW

R&D Building

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
A	AIR-CIRCULATION SYSTEM:
1	FLOOR MOUNTED (FOR NONCRITICAL AREA):
	Supply, Installation, Testing and commissioning of factory fabricated Double skinned construction with Thermal Break Profile with (0.8mm) pre coated GSS from outside & (0.8mm) GSS on inside with PUF Insulation of casing thickness (min. 40 mm) and density (min. 42+ 2kg/cum) between them. AHU may be floor mounted & should be of sufficient Tonnage, CFM & static pressure as per requirements.
	Maximum air face velocity across filters/Coils shall be 2m/sec. Velocity & friction factor for Pipe Sizing shall be in conformance to relevant standards. Volume control dampers to be provided in ducts as per requirements. TEFC drive IE-3 motor suitable for 415 ± 10% volts, 50Hz, 3 Phase AC supply. All AHUs shall be equipped with VFDs. Fan should be backward curved Airfoil blade Plug Type for supply/exhaust. Fans must be selected for suitable Static Pressure & CFM. Multiple plug fans should be selected with minimum efficiency of 70%. All AHUs shall be space provision for Electronic Air Filtration System (MERV-14) & AHU coil mounted UVGI system. Cooling/Heating Coil of required OD & thickness made of Copper with Fins made of Aluminum with suitable fins/inch. Cooling/Heating Coils Row deep should be considered meeting the functional requirements. Header must be in copper. Drain Pan of AHUs must be made of Stainless Steel of Suitable thickness (20 G). AHU floor should be insulated with 50mm thick throughout the unit.
	DDC Panel & Instrument kit to be considered
	Suitable Foundation for Floor Mounted AHUs should be considered with anti-vibration pads. Fire retardant double canvass connection should be considered.
1.1	Airflow = 12500 cfm / TSP = 500 Pa / Cooling Capacity = 106.59 TR / Horizontal / Fresh Air= 10500 cfm, 8RD Cooling Coil
1.2	Airflow = 10000 cfm / TSP = 500 Pa / Cooling Capacity = 46.33 TR / Horizontal / Fresh Air= 3750 cfm, 6RD Cooling Coil
1.3	Airflow = 9500 cfm / TSP = 500 Pa / Cooling Capacity = 44.20 TR / Horizontal / Fresh Air= 3800 cfm, 6RD Cooling Coil
1.4	Airflow = 8000 cfm / TSP = 500 Pa / Cooling Capacity = 41.16 TR / Horizontal / Fresh Air= 3500 cfm, 6RD Cooling Coil
1.5	Airflow = 7500 cfm / TSP = 500 Pa / Cooling Capacity = 49.44 TR / Horizontal / Fresh Air= 4550 cfm, 8RD Cooling Coil
1.6	Airflow = 7500 cfm / TSP = 500 Pa / Cooling Capacity = 34.47 TR / Horizontal / Fresh Air= 2250 cfm, 6RD Cooling Coil
1.7	Airflow = 4500 cfm / TSP = 500 Pa / Cooling Capacity = 36.35 TR / Horizontal / Fresh Air= 3650 cfm, 8RD Cooling Coil
1.8	Airflow = 4000 cfm / TSP = 500 Pa / Cooling Capacity = 18.79 TR / Horizontal / Fresh Air= 1250 cfm, 6RD Cooling Coil
2	HEAT RECOVERY UNIT

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
	Supply, Installation, Testing and commissioning of factory fabricated Double skinned construction with Thermal Break Profile with (0.8mm) pre coated GSS from outside & (0.8mm) GSS on inside with PUF Insulation of casing thickness (min. 40 mm) and density (min. 42± 2kg/cum) between them. AHU may be floor mounted & should be of sufficient Tonnage, CFM & static pressure as per requirements.
	All HRUs shall have fresh and return air sections with dampers, pre-filters, fans and plate type heat-exchange within it. Pressure drop of the heat exchanger should be selected within maximum pressure level of 200Pa. Maximum air face velocity across filters/Plate type heat-exchanger shall be 2m/s. TEFC drive IE-3 motor suitable for 415 ± 10% volts, 50Hz, 3 Phase AC supply. All HRUs shall be equipped with VFDs. Fan should be backward curved Airfoil blade Plug Type for supply/exhaust. Fans must be selected for suitable Static Pressure & CFM. Multiple plug fans should be selected with minimum efficiency of 70%. All HRUs shall be with bag type pre-filters with a class of G4 for exhaust & space provision for ESP filter for supply of the plate type heat exchanger. All units should have diffuser section after fan section to maintain laminarity in the supply
	Suitable Foundation for Floor Mounted HRUs should be considered with anti-vibration pads.
	HEAT EXCHANGER Specification The Heat Exchanger should consist of specially formed aluminum plates. Its profile has been optimized through extensive testing for thermal efficiency, pressure drop and rigidity. The plates are joined together via an interlocking fold. This means that the material is several times thicker at the air inlet and outlet, makes the exchanger package extremely rigid. The minimum efficiency of the plate heat exchanger should be 50%. The exchanger package is fitted into a casing of connection profiles and side walls. The corners of the exchanger package are sealed into the Aluzinc sheet steel connection profiles with a sealing compound. The side walls made of Aluzinc sheet steel are riveted onto the connection profiles. Standard construction type- The side walls of the casing have a double-folded edge. This facilitates the handling of the exchanger with lifting tools and enables control dampers to be mounted. The side walls of the casing should flat. That creates more space for the exchanger package and thus greater performance. Counter-flow plate heat exchangers for energy recovery, consisting of the exchanger package and the casing. The exchanger package consists of aluminum plates with pressed-in spacers; condensate drainage is possible in every direction, depending on the installation position.
	The plates are connected by a fold, which gives a severalfold material thickness at air entry and exit. The corners of the exchanger package are sealed into especially rigid Aluzinc sheet steel connection profiles in the casing with a sealing compound. The side walls of Aluzinc sheet steel are riveted tightly to these extrusions. The suitability of the exchangers for use both in general ventilation technology and in hospitals is certified by independent test institutes. The width of the plate heat exchangers can be selected in steps of 1 mm. In order to simplify transport and very wide exchangers are delivered in 2 parts. Several exchangers with dampers are linked with connecting bolts when installed into the air handling unit. A connecting bolt is installation also supplied. It should have Aluminium plates and aluzinc sheet steel; differential pressure stability: max. 2000 Pa; silicone-free; resistant to 80deg C.
2.1	Airflow Supply = 23000 cfm / TSP = 550 Pa / Airflow Exhaust = 12250 cfm / TSP = 500 Pa / Heat Recovery Plate type
2.2	Airflow Supply = 11000 cfm / TSP = 550 Pa / Airflow Exhaust = 5900 cfm / TSP = 500 Pa / Heat Recovery Plate type

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
3	UVGI SYSTEM (AHU MOUNTED):
	Supplying, Installing, Testing and Commissioning of AHU coil mounted UVGI system for maintaining Indoor Air Quality & Deep Coil Cleaning. The system shall include UV modules with different lamp sizes from 450 mm to 900 mm to cater all type AHU Coil sizes .UVGI System shall be suitable for a UV dose of greater than 5,00 µJ/cm ² in a single pass to achieve kill rate at least 99% (log 2) of virus/bacteria susceptible to this dose, the uv system shall be with control panel with BMS connectivity. UVGI system supplied must be in strict conformity with the specifications. Vendor should have experience of supplying UV systems of minimum 5 years.
3.1	AHU's 1000 CFM to 5000 CFM
3.2	AHU's 5001 CFM to 8000 CFM
3.3	AHU's 8001 CFM to 13000 CFM
4	ELECTROSTATIC FILTER:
	Supplying, Installing, Testing and Commissioning of filter section central air cleaner a hybrid air purification system that improves the indoor air quality through reducing harmful pollutants like particulate matter (PM _x), PM 2.5, allergens, pollen, smoke, bacteria, pathogens based on Electrostatic precipitation technology. Other forms of air filtration systems such as charged media filters, dielectric media filters, or ionizers (which do not have second stage collector plates) shall not be acceptable. It should be a monobloc structured unit specifically designed for integration in Return Air path of the AHU, to centrally capture the pollutants. It should be equivalent to MERV14 efficiency @ 2000 cfm with low pressure drop of not more than 65Pa @ 492fpm (certification for the same to be provided). It should be UL certified with in built provision to connect to BMS.
	The product has to be certified as a green product by any of the Green Building councils across the world . The central air cleaner units must have a valid ANSI/ASHRAE 52.2 test report to verify filtration efficiency. The unit must have factory test report to ensure that it meets the following safety and environmental criteria with reference to ES164468, UL 867 and DA 6.2.1. Ozone level of units provided must be within the acceptable limit of 0.05ppm. The units shall have local LEDs at each individual unit to indicate when the units are up for wash/malfunctioning
4.1	Single module (1000 cfm)
4.2	Double module (2000 cfm)
5	AIR COOLED INVERTER HI WALL UNIT:
	Supply, Installation, Testing and Commissioning of inverter air cooled Split airconditioning unit of BEE 5 star rating consist of outdoor unit, indoor unit wireless remote control the outdoor unit shall comprise of rotary / reciprocating compressor, refrigerant should be CFC free, air-cooled condenser, fan, fan motor with corded remote controller, electrical accessories & suitable stand of MS angle iron painted with anti rusted treatment for installation of outdoor unit the indoor unit shall be decorative Hi-wall type complete with cooling coil, drain pan washable pre filter first charge of refrigerant complete with suitable capacity voltage stabilizer etc as reqd for voltage range of 100V~300V. Unit shall be supplied fully refrigerant charged plus additional top up of refrigerant to suit piping length. Unit shall be suitable for working under long length of refrigerant piping up to 20 meter minimum. Refrigerant piping (Pair) up to 20 meter price to be included . The condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air.

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
5.1	2.0 TR Capacity (2W+1S)
B	WATER PIPING:
1	Supplying, laying/ fixing, testing and commissioning of following nominal sizes of chilled water piping plumbing inside the building (with necessary clamps, vibration isolators and fittings but excluding valves, strainers, gauges etc.) duly insulated with fire retardant quality expanded polystyrene moulded pipe section of density 20 kg/cu.m after a thick coat of cold setting adhesive (CPRX compound) wrapping with 500g polythene faced hessain and finally applying 0.63mm aluminium sheet cladding complete with type3 , grade 1 roofing feltstrip(as per IS:1322 as amended up to date) at joints repairing of damage to building etc. as per specifications and as required complete in all respect. The pipes shall be joined using Grooved Fittings conforming to ASTM Grade A-536. The Grooved Couplings shall be Standard OGS Groove from 20 NB - 12". Installation Ready Coupling shall be used from 2"-12" and shall be conform to AGS Grooving from 14" & above
	Note:-The Pipes of sizes 150mm & below shall be M.S. 'C' class as per IS : 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes upto 350 mm dia. and from minimum 7mm thick MS sheet for pipes of 400 mm dia and above. The pipes shall be joined using Grooved Coupling
1.1	150 mm dia MS pipes (75 mm insulation)
1.2	125 mm dia MS pipes (50 mm insulation)
1.3	100 mm dia MS pipes (50 mm insulation)
1.4	80 mm dia MS pipes (50 mm insulation)
1.5	65 mm dia MS pipes (50 mm insulation)
1.6	50 mm dia MS pipes (50 mm insulation)
2	Condensate Drain Piping:
	Providing and fixing G.I. pipes complete with G.I. fittings and clamps, i/c cutting and making good the walls etc for condensate drain.
2.1	40 mm dia
3	Condensate Drain Piping Insulation:
	Supplying, laying/ fixing of following thickness insulation with fire retardant quality expanded polystyrene moulded pipe section of density 20 kg/cu.m after a thick coat of cold setting adhesive (CPRX compound) wrapping with 500g polythene faced hessain and finally applying 0.63mm aluminium sheet cladding complete with type3 , grade 1 roofing feltstrip(as per IS:1322 as amended up to date) at joints repairing etc. as per specifications and as required complete in all respect.
3.1	50 mm
4	Insulated Valves:
	Supplying, fixing, testing and commissioning of following valves, strainers, gauges in the chilled water plumbing duly insulated to the same specifications as the connected piping and adequately supported as per specifications.
4.1	BUTTERFLY VALVE (MANUAL) with C I body SS Disc, Nitrile Rubber Seal & O- Ring PN 16 pressure rating for chilled water/ hot eater circulation as specified.

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
4.1.1	100 mm dia
4.1.2	80 mm dia
4.1.3	65 mm dia
4.1.4	50 mm dia
4.2	Y - STRAINER of Ductile CI Body flanged ends with stainless steel strainer for chilled/ hot water circulation including insulation as specified.
4.2.1	100 mm dia
4.2.2	80 mm dia
4.2.3	65 mm dia
4.2.4	50 mm dia
4.3	PICB Valve
	Supplying, fixing, testing and commissioning Electronic, self-balancing, pressure independent type dynamic balancing valve with integrated 2 way modulating control valve in a single body. The actuator shall be capable of accepting upto 10V DC and upto 20 mA electric signal and shall provide similar transduced feedback output to control system. Maximum close off pressure shall not be less than 6 Bar for upto 50 mm valves and 7 Bar for 65 mm & above. Valves should have pressure rating of 25 Bar minimum.
4.3.1	100 mm dia
4.3.2	80 mm dia
4.3.3	65 mm dia
4.3.4	50 mm dia
4.4	Providing and fixing in position the industrial type pressure gauges with gun metal / brass valves complete as required.
4.5	Providing & fixing in position the mercury in glass industrial type thermometers.
	Thermostat
4.6	Providing and fixing of thermostat for dual mode both heating and cooling along with sensor and control cabling. (BMS compatible) Semi Flush-mount room temperature controllers with LCD display, 24V AC Model RDU340/ equivalent
	Automatic air vent
4.7	Supply, installation, testing and commissioning of 10mmdia. Automatic air vent in brass construction complete with nipples, union etc. as required at all high points in the pipe lines. The valve shall be such as to have non-return valve as integral part of the vent.
5	Groove Fittings:
	Providing, laying, jointing, testing and commissioning of following sizes of Grooved Couplings & Grooved Fittings in pipes for Chilled Water and Condensor Water Lines including all accessories. The Grooved Fittings shall be supplied by manufacturer of grooved Couplings The Couplings should not need any torque to tighten upto 12". Tongue & Recess Couplings are not allowed. Angle Pad Design Grooved Couplings are allowed. The Minimum working pressure rating should be above 400 psi for these sizes upto 12" The Couplings from 14" and above should need AGS Groove Welding is not allowed to join pipes
5.1	Grooved Couplings

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
5.1.1	150 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.2	125 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.3	100 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.4	80 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.5	65 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.1.6	50 NB with Grade "EHP" EPDM having temperature rating between -34°C to +121°C
5.2	Grooved Elbows
5.2.1	150 NB
5.2.2	125 NB
5.2.3	100 NB
5.2.4	80 NB
5.2.5	65 NB
5.2.6	50 NB
5.3	Grooved Reducers
5.3.1	150 NB
5.3.2	125 NB
5.3.3	100 NB
5.3.4	80 NB
5.3.5	65 NB
5.3.6	50 NB
5.4	Grooved Equal Tees
5.4.1	150 NB
5.4.2	125 NB
5.4.3	100 NB
5.4.4	80 NB
5.4.5	65 NB
5.4.6	50 NB
5.5	Grooved Unequal Tees
5.5.1	150 NB
5.5.2	125 NB
5.5.3	100 NB
5.5.4	80 NB
5.5.5	65 NB
5.5.6	50 NB
5.6	Grooved Flange Adapters
5.6.1	100 NB
5.6.2	80 NB
5.6.3	65 NB
5.6.4	50 NB
6	Providing, laying, jointing, testing and commissioning Three Grooved Flexible Coupling to be installed as expansion joints in each location for Chilled water piping located at Pump inlet & exit, AHU inlet & exit and at chiller inlet & exit ahu. Complete with all fittings, necessary hardware and gaskets etc., with insulation of following sizes:
6.1	100 mm dia

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
6.2	80 mm dia
6.3	65 mm dia
6.4	50 mm dia
C	DUCTING AND GRILLES
1	Ducting
	Supply, installation, balancing and commissioning of factory fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following gauges:- Note: Fabrication and jointing of duct shall be as per IS standard and hanging shall be as per SMACNA.
1.1	Thickness 0.63 mm sheet
1.2	Thickness 0.80 mm sheet
1.3	Thickness 1.00 mm sheet
1.4	Thickness 1.25 mm sheet
2	Supply, installation, balancing and commissioning of Site fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following gauges:-
2.1	Thickness 0.63 mm sheet
2.2	Thickness 0.80 mm sheet
2.3	Thickness 1.00 mm sheet
2.4	Thickness 1.25 mm sheet
3	Supply, installation, testing and commissioning of GI volume control duct damper complete with neoprene rubber gaskets, nuts, bolts, screws linkages, flanges etc., as per specifications.
4	Supplying & fixing of powder coated extruded aluminium Supply Air Grills/ exhaust with aluminium volume control dampers as per specifications.
5	Supplying & fixing of powder coated extruded aluminium Supply/Return Air Grills with louvers but without volume control dampers complete as required.
6	Supplying, fixing testing commissioning of supply air diffusers of powder coated aluminium with aluminium volume control dampers with anti smudge ring & removable core.
7	Supplying, fixing testing commissioning of Return air diffusers of powder coated aluminium without volume control dampers with anti smudge ring & removable core.

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
8	Supplying, Fixing, testing and commissioning of fire dampers in supply air duct/main branch and return air path as and where required of required sizes i/c control wiring, the damper shall be motorized and spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored. The spring return action shall be inbuilt mechanism and not externally mounted. The damper shall also be closed in the event of fire signal complete as required and as per specifications.
8.1	Fire damper
8.2	Actuator
9	AC Ducting (PIR-Pre-Insulated) Internal (Running in AC area)
	Supply Installation testing Commissioning of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel/Board should be CFC/HCFC Free Green Pro & Griha Certified. Thickness is 20mm , Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, base material is Impermeable to moisture and Insoluble, Certified Anti Rodent type material. Can withstand 1500 pa pressure without any deformation and change in insulation, chemical or physical characteristics. The Aluminium Foil shall be 80μ outer side & chequered aluminium thick and provided on inner sides of Panel and the foil shall be embossed from outside and smooth from inside. The fire and smoke classification shall comply to Class "O" of BS 476 part 6 & 7 & Class A ASTM E 84 respectively. Toxicity Index shall not exceed 6. Along with all standard accessories as per manufacturer Standard including profiles, jointers, Adhesives, Sealants & Aluminium tapes The duct Installation shall be Confirming to installation norms of DW-144 and other relevant specifications and standards mentioned in the detailed specifications for Internal Duct Shall be hang through wire rope.
10	AC Ducting (PIR-Pre-Insulated) Internal (Running in Non-AC area)
	Supply Installation testing Commissioning of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel/Board should be CFC/HCFC Free Green Pro & Griha Certified. Thickness is 30mm , Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, base material is Impermeable to moisture and Insoluble, Certified Anti Rodent type material. Can withstand 1500 pa pressure without any deformation and change in insulation, chemical or physical characteristics. The Aluminium Foil shall be 80μ inner side & 80 micron Upper side, the foil shall be embossed from both the sides. The fire and smoke classification shall comply to Class "O" of BS 476 part 6 & 7 & Class A ASTM E 84 respectively. Toxicity Index shall not exceed 6. Along with all standard accessories as per manufacturer Standard including profiles, jointers, Adhesives, Sealants & Aluminium tapes The duct Installation shall be Confirming to installation norms of DW-144 and other relevant specifications and standards mentioned in the detailed specifications for external/ shaft Duct Shall be hang with Rigid Supports. i.e threaded rod with MS angle.
11	AC Ducting (PIR-Pre-Insulated) Internal (Running in Shaft or On Terrace)

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
	Supply Installation testing Commissioning of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel/Board should be CFC/HCFC Free Green Pro & Griha Certified. Thickness is 30mm , Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, base material is Impermeable to moisture and Insoluble, Certified Anti Rodent type material. Can withstand 1500 pa pressure without any deformation and change in insulation, chemical or physical characteristics. The Aluminium Foil shall be 80μ inner side & 200 mircon Upper side , the foil shall be embossed from both the sides. The fire and smoke classification shall comply to Class "O" of BS 476 part 6 & 7 & Class A ASTM E 84 respectively. Toxicity Index shall not exceed 6. Along with all standard accessories as per manufacturer Standard including profiles, jointers, Adhesives, Sealants & Aluminium tapes The duct Installation shall be Confirming to installation norms of DW-144 and other relevant specifications and standards mentioned in the detailed specifications for external/ shaft Duct Shall be hang with Rigid Supports. i.e threaded rod with MS angle. Weather proof Lag coating shall be applied
12	AHU Room Acoustic Lining
	Providing and fixing of acoustic lining on wall and ceiling of AHU rooms with 25mm thick Rigid Board of Glass wool one side aluminum faced and other side black glass cloth lamination, density 70 to 80 kg/cu.m
13	VAV Boxes
	Supply, installing, testing and commissioning of PRESSURE INDEPENDENT VARIABLE AIR VOLUME Terminal units, suitable for installtion in horizontal ducts. The casing shall be made of minimum 0.8mm GSS internally lined with engineered polymer foam insulation .VAV box should be cetified by AHRI 880/ASHRAE 130. This shall include all accessories such as Factory Fitted Transformer, Hanger Brackets, single / multileaf damper (with equal % characteristics) etc. actuators, control cabling , digital dispaly Thermostat , and any other ancillary requirement for the functioning of the units. The VAVs shall be suitable for Bacnet Output and factory calibrated for air capacities.
	VAV boxes shall be suitable for following air flow capaccitties.
13.1	100-3000 CFM
	Note :
	Quoted price shall include the following:
	a. Cooling / heating thermostat with ON/OFF control
	b. Differential pressure sensor
	c. 24 Volt power supply unit for each VAV box.
14	VARIABLE FREQUENCY DRIVES (VFD)
	Supply, installing, testing and commissioning of HVAC dedicated VFDs suitable for the following AHU fan motor capacity (The integration of the VFD with AHU is included in this item) with IP 21 The VFD must be designed specifically for the HVAC Application market and shall be a low Harmonic solution contained within VFD, not requiring any external hardware (like filters/ transformers) and not require any additional wiring(i.e. 3 wire in 3 wire out). This shall be achieved using Active rectifier topology based VFD with IGBTs in both converter & inverters along with DC bus capacitors. VFDs without DC bus capacitors are not acceptable
	Built-in dual DC chokes and inbuilt active harmonic filters to control TDHi less than 5 % at all loads at equipment/VFD level only.
	Built-in EMC class-C2, Functional safety STO (SIL3 – PLe), Conformal coated PCB suitable for 3C2 & 3S2 environments and this product shall comply to CE, UL, CUL, Eco Design, Low voltage directive, ROHS, WEEE, RCM, EAC standards.

SCHEDULE OF ITEMS FOR HVAC WORKS (R&D Building)	
S. No.	Description of item
	Two-feedback PID (Proportional integrated derivative) controller having capability to simultaneously accept 2 feedback signals from temperature sensors for process optimization and accordingly regulate the speed of the AHUs.
	VFD shall deliver >96% efficiency, Unity total power factor (PF total=1), shall able to deliver full voltage to motor when needed even in low line voltage conditions and shall reduce electrical network losses and improve transformer utilization and should be generator friendly.
	The VFD shall be compatible with BMS through MODBUS/BACNET
14.1	VFD's for AHU's feeding VAV Boxes and to be controlled on feedback from Differential pressure switch's/ Differential pressure Sensors to modulate AHU fan speed as per different rooms temperature/RH requirement.
14.1.1	4 KW
14.2	VFD's for AHU's feeding directly through ducts without VAV Boxes and to be controlled on feedback from temperature/ RH sensors to modulate AHU fan speed as per different rooms temperature/RH requirement. (Price shall include T+RH sensor and control wiring)
14.1.2	4 KW

Guest House Building

SCHEDULE OF ITEMS FOR HVAC WORKS (GUEST HOUSE)	
S. No	Description of item
A	VRV/VRV SYSTEM:
1	VRV/VRV OUT DOOR UNITS:
	Supply Installation, Testing & Commissioning of modular type Variable Refrigerant Flow/ Variable Refrigerant Volume air cooled Outdoor units suitable for cooling and heating, having all hermetically sealed inverter type Scroll Compressor(s), minimum two compressors for above 14 HP modules, microprocessor based Controller, top discharge type condensing unit(s), with R 410 A Refrigerant, vibration isolators, with suitable foundation etc. complete as required. The unit shall deliver the rated capacity at AHRI Conditions and work even at 50°C ambient temperature without tripping. The unit shall be suitable to work on 400V +/- 10%, 3 Phase, 50Hz AC power supply. The unit shall be filled with first charge of the refrigerant and ready for use as required. The COP at AHRI conditions shall not be less than 3.1 and IEER not less than 6.5. Below Capacity to be meet after detation @ 43.33°C ambient temperature
	(Suitable for cooling and Heating)
1.1	32.0 HP
1.2	28.0 HP
2	VRV/VRV INDOOR UNIT-HIGH WALL TYPE:
	Supply, installation, testing and commissioning of following minimum capacity VRV/VRV High wall type Indoor unit equipped with washable synthetic media pre-filter, fan section with low noise fan/dynamically balanced blower, multi speed motor, coil section with DX copper coil, electronic expansion valve, outer cabinet, cordless remote control, drain pan, necessary accessories etc., suitable for operation on 230V±10%, 50Hz, single phase AC supply, complete as required. The unit shall have automatic force shut down provision in case of fire on receiving signal from BMS System. The cooling capacity of indoor unit will be at air inlet conditions of 27 Degree C DB and 19 Degree C WB temperature.
2.1	1.59 TR
3	VRV/VRV INDOOR UNIT-DUCTABLE TYPE:
	Supply, installation, testing and commissioning of following minimum capacity and external static pressure VRV/VRV ceiling mounted ductable type Indoor unit equipped with washable synthetic media pre-filter, fan section with low noise fan/dynamically balanced blower, multi speed motor, coil section with DX copper coil, electronic expansion valve, corded remote control, outer cabinet, vibration isolators, drain pan, other necessary supports etc., suitable for operation on single phase AC supply 230V±10%, 50Hz complete as required. The unit shall have automatic force shutdown provision in case of fire on receiveing signal from BMSS system. The cooling capacity of indoor unit will be at air inlet conditions of 27 Degree C DB and 19 Degree C WB temperature.
	Low static ductable units (minimum 25 pascal external static pressure)
3.1	1.03 TR
	Mid Static Ductable units (minimum 45 pascal external static pressure)
3.2	3.98 TR
	High Static Ductable units (minimum 110 pascal external static pressure)
3.3	4.55 TR

SCHEDULE OF ITEMS FOR HVAC WORKS (GUEST HOUSE)	
S.	Description of item
4	VRV/VRV COPEER REFRIGERANT PIPING
	Supply, Installation, testing and commissioning including vaccumiazation and Nitrogen testing of following nominal sizes of soft/hard drawn copper refrigerant piping for VRV/VRF system, complete with fittings, with suitable adjustable ring type hanger supports, jointing/ brazing including accessories, insulated with XPLE Class-O tubular insulation/ with Class-O closed cell elastometric nitrile rubber tubular sleeves sections of specified thickness as given below for Suction and Liquid lines, all accessories (including Y-joint, T-joint) as per specifications etc. as required :
4.1	6.4 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
4.2	9.5 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
4.3	12.7 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
4.4	15.86 mm dia (OD) (Soft drawn) with tube thickness 1.2 mm with 19 mm thick insulation
4.5	19 mm dia (OD) (Hard drawn) with tube thickness 1.2 mm with 19 mm thick insulation
4.6	22.2 mm dia (OD) (Hard drawn) with tube thickness 1.2 mm with 19 mm thick insulation
4.7	28.58 mm dia (OD) (Hard drawn) with tube thickness 1.2 mm with 19 mm thick insulation
4.8	34.9 mm dia (OD) (Hard drawn) with tube thickness 1.62 mm with 19 mm thick insulation
5	DRAIN PIPING
	Providing and fixing of uPVC drain pipe of 10 Kg/m ³ complete with 9mm thick closed cell nitrile rubber insulation, fittings, supports, valves as per specifications & drawings
5.1	25 mm dia OD
5.2	32 mm dia OD
6	CONTROL WIRING with Conduit
6.1	Supply, installation, testing and commissioning of 20 mm PVC conduitas per specifications (for transmission)
6.2	Supply, installation, testing and commissioning of 2core X 1.5 mm ² copper wire in per specifications (for transmission)
B	MECHANICAL VENTILATION SYSTEM:
1	AIRWASHER:

SCHEDULE OF ITEMS FOR HVAC WORKS (GUEST HOUSE)	
S.	Description of item
	Supplying, Installing, Testing and Commissioning of CELDEK FILL package type air cooling unit with minimum 90% saturation efficiency. Air cooling unit shall be factory assembled and complete with double skin casing 0.8mm Inner/ outer pre-coated GI sheets, DIDW forward curved fans with TEFC, sq. cage, 1440 induction motors(IE-2) with IP-55 Protection suitable for operation on $415 \pm 10\%$ voltage, 50 Hz A/c 3 phase, drive package including multi sheave pulleys and belts for fans and motors, 1.2mm thick tank & pad section in SS Construction, vibration isolators, HDPE pre-filters, 200 mm thick CELDEK FILL, Water Circulation Pump (1W+1S), internal PVC piping, valves and fittings with built in 4-bend PVC eliminator. The Unit shall be following capacities.
1.1	1500 CFM at 50 mm static pressure for Kitchen
2	DRY SCRUBBER:
	Supply, Installation, Testing and Commissioning of double skin type dry type scrubber (packaged type) comprising of following as per the specifications :
	Casing of scrubber shall be in double skin construction. Inner skin shall be constructed out of 24 gauge plain GS sheet & outer skin in 24 gauge pre-plasticized GS sheet sandwiched between 50mm thick injected PU foam insulation of density not less than 40 Kg /CuM and complete with inspection doors including control wiring as required. Scrubber shall have access for all parts.
	Fan section complete with backward curved DIDW type centrifugal fan/s, TEFC squirrel cage induction motor suitable to operate on $415+10\%V$, 50Hz, 3 phase AC power supply and belt drive package. Centrifugal fans shall be coated with epoxy paint as specified. Fan outlet velocity shall not be more than 2000 FPM (10.16 MPS)
	The Electrostatic section shall be 90-95% in single pass as per DOP test method. Electrostatic Precipitator should be able to charge particles from 0.01 micron to 10 micron through solid state power supply. Collector cell shall be of permanent type and slide out facility for easy removal for cleaning. Operating voltage shall be $220+6\%$ volts, 50 Hz/ 1Ph, power consumption shall not exceeding 50 watts per unit upto 7500 Cfm. System should be fitted with interlock switch for safety. Velocity across the air cleaner shall not be more than 500 FPM. Scrubber shall be provided with pre-filters as required.
2.1	2300 cfm at 50 mm static pressure for Kitchen
3	INLINE FAN THREE PHASE
	Supply, Installation, Testing and commissioning of exhaust air fan section suitable for Inline mounting comprising of SISW/DIDW (CABINATE) complete with external rotor induction motor / Induction 3 phase motor, earthing, canvas connection all compete as required, suitable for three phase, 415volts, 50Hz AC. supply as per specifications of following capacities: Fan should be AMCA certified. Noise level should not exceed 70dB(A)at 3 meter in room condition.
3.1	5600 cfm at 40 mm static pressure for toilet
	SUB TOTAL (B) CARRIED OVER TO SUMMARY
C	DUCTING AND GRILLES
1	Ducting

SCHEDULE OF ITEMS FOR HVAC WORKS (GUEST HOUSE)	
S.	Description of item
	Supply, installation, balancing and commissioning of factory fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following gauges:- Note: Fabrication and jointing of duct shall be as per IS standard and hanging shall be as per SMACNA.
1.1	Thickness 0.63 mm sheet
1.2	Thickness 0.80 mm sheet
1.3	Thickness 1.00 mm sheet
1.4	Thickness 1.25 mm sheet
2	Supply, installation, balancing and commissioning of Site fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following gauges:-
2.1	Thickness 0.63 mm sheet
2.2	Thickness 0.80 mm sheet
2.3	Thickness 1.00 mm sheet
2.4	Thickness 1.25 mm sheet
3	Supply, installation, testing and commissioning of GI volume control duct damper complete with neoprene rubber gaskets, nuts, bolts, screws linkages, flanges etc., as per specifications.
4	Supplying & fixing of powder coated extruded aluminium Supply Air Grills/ exhaust with aluminium volume control dampers as per specifications.
5	Supplying & fixing of powder coated extruded aluminium Supply/Return Air Grills with louvers but without volume control dampers complete as required.
6	Supplying, fixing testing commissioning of supply air diffusers of powder coated aluminium with aluminium volume control dampers with anti smudge ring & removable core.
7	Supplying, fixing testing commissioning of Return air diffusers of powder coated aluminium without volume control dampers with anti smudge ring & removable core.
8	AC Ducting (PIR-Pre-Insulated) Internal

SCHEDULE OF ITEMS FOR HVAC WORKS (GUEST HOUSE)	
S.	Description of item
	<p>Supply Installation testing Commissioning of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel/Board should be CFC/HCFC Free Green Pro & Griha Certified. Thickness is 20mm, Density of PIR foam 45 kg/m³, Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, base material is Impermeable to moisture and Insoluble, Certified Anti Rodent type material. Can withstand 1500 pa pressure without any deformation and change in insulation, chemical or physical characteristics. The Aluminium Foil shall be 80µ outer side & chequered aluminium thick and provided on inner sides of Panel and the foil shall be embossed from outside and smooth from inside. The fire and smoke classification shall comply to Class "O" of BS 476 part 6 & 7 & Class A ASTM E 84 respectively. Toxicity Index shall not exceed 6. Along with all standard accessories as per manufacturer Standard including profiles, jointers, Adhesives, Sealants & Aluminium tapes The duct Installation shall be Confirming to installation norms of DW-144 and other relevant specifications and standards mentioned in the detailed specifications for Internal Duct Shall be hang through wire rope.</p>

SCHEDULE OF ITEMS FOR BMS WORKS	
S. No.	Description of item
	SUPPLY, INSTALLATION, TESTING, COMMISSIONING & HANDING OVER OF THE FOLLOWING:
1.00	CENTRAL CONTROL SERVER
a	<ul style="list-style-type: none"> • Intel® Xeon® CPU E5-2640 x64 (or better) compatible with dual and quad core processors; • Windows 11 (64 bit), Enterprise, Ultimate, 64 bit), Windows Server 2012 R2 (Standard, Enterprise, 64 bit); Windows Server 2016;•8 GB minimum, 16 GB or more recommended for larger systems ; • Video card and monitor capable of displaying at 1024 x 768 resolution, or greater; •If enterprise-level data archiving is required (optional)one of the following compatible database applications will need to be installed (MS SQL Server 2012 or MS SQL Server 2016)
b	Client PC System: Intel core i3 2.93 GHz,E7500,3mb cache,1066Mhz FSB, 4GB DDR3-1066/1333 Expandable up to 8GB, 500 GB SATA Hard Disk, DVD Writer, Lan Card 10/100/1000 base-T, Optical Mouse, 104 Keys Keyboard, Windows 11, Inbuilt graphics Intel chipset (1 GB NVIDIA graphics media accelerator card),
c	A 4 size Inkjet colour Printer suitable for the application, with driver software.
e	Display monitore for BMS Graphical User Interface - LED 32 Inch
	Supply, Installation, Testing & Commissioning of 10/100/1000 Base-T Switch with IP multicast snooping and data-driven IGMP support and with 1000 baseT FO uplink ports and all related termination accessories as per vendor specific System requirement. (Pigtail,Sleeve, Patch Chords, termination etc)
a	8 Port Switch
b	16 Port Switch
c	32 Port Switch
2.00	SOFTWARE
a	Supply, Installation, Testing and Commissioning of BMS System Software : The BMS GUI software should not require additional software (to enable a standard Web browser) to be resident on the DDC / client machine, or manufacture-specific browsers shall not be acceptable. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Storage of the graphical screens (Static) shall be stored in DDC directly and should not depend on any other hardware. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. This data shall reside on a server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a Master / Global / Host to pass data shall NOT be acceptable. Physical connection of BACnet devices shall be via Ethernet at all levels. The License must be provided with mimimun of 25 concurrent user licenses by default. 25 analytic points license should be included with software by default. - Life Time Lincense
3.00	DDC CONTROLLERS WITH IP

SCHEDULE OF ITEMS FOR BMS WORKS	
S. No.	Description of item
	SUPPLY, INSTALLATION, TESTING, COMMISSIONING & HANDING OVER OF THE FOLLOWING:
	DDC CONTROLLERS : Supply, Installation, Testing and Commissioning of IP Based DDC controllers. DDC controllers shall be capable of fully "stand- alone" operation i.e. In the event of loss of communication with other DDC's or Control Station, they shall be able to function on their own. The controllers shall consist of single/dual 32 bit microprocessors for reliable throughput, with EPROM based operating system on BACNET. Master Slave Topology is NOT acceptable. The Controller which route the messages or data sharing through the system or any intermediate hard ware / controller shall not be acceptable. Each DDC on field level shall have embedded TCP/IP (10/100Mbps) connectivity so that it can be hooked into the Local Area Network (LAN) provided by the client / can be on dedicated network created by the vendor. Each DDC can be accessed from the Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server. All controllers shall accept 230V, 50Hz Uninterrupted power supply, provided by end user, directly so that the in between hardware such as transformers and SMPS are avoided. Controller shall support DHCP addressing over Local Area Network (LAN) so that the static IP requirements are reduced however a single static IP shall be provided for system so that it can be hosted on to internet in consultation with end user / consultant. The microprocessor based DDC's shall be provided with power supply, A/D and D/A converters, memory and capacity to accommodate a maximum of 192 input/output (I/O) hardware points (with or without an expansion board). Each DDC should have minimum 10 UI & 6 AO points on board without any expansion module. 15% spares should be considered. Each DDC on field level should have minimum 128MB RAM & 64MB Flash memory. All controllers should be mandatorily BTL Approved with B-BC profile.
3.a	DDC Controller for Non Critical AHU's - 2 Nos on one DDC
3.b	DDC Controller for Critical AHU's - 1 Nos on one DDC
3.c	DDC Controller for OT AHU's - 1 Nos on one DDC
3.d	DDC Controller for Pressurization Fans
3.e	DDC Controller for Axial Fans
3.f	DDC Controller for Breaker Status
3.g	DDC Controller for Plumbing System
3.h	DDC Controller for Fire Fighting System
3.i	DDC Controller for DG Tanks
4.00	PORTABLE OPERATOR TERMINAL
	Portable Operator Terminal : capable of connecting to one of the Controllers on the Communication bus and view parameters of the complete system. The Terminal should be capable of viewing / changing parameters and trend the specified parameters as per requirement
5.00	INTEGRATION

SCHEDULE OF ITEMS FOR BMS WORKS	
S. No.	Description of item
	SUPPLY, INSTALLATION, TESTING, COMMISSIONING & HANDING OVER OF THE FOLLOWING:
	<p>The 3rd party Integration unit shall provide the interface between Ethernet LAN and the 3rd party field control devices or any other devices which need to be integrated. These shall also provide supervisory capability of functions over the devices connected to it. The purpose of using these units should be limited to integrate devices only, not for any DDC interface with GUI, provided by others.</p> <p>The Unit must provide the following hardware features as a minimum:</p> <p>a. Two No. on Board RS-485 port</p> <p>b. Provision to include / add additional communication card</p> <p>c. Two onboard Ethernet port</p> <p>d. 4GB memory</p> <p>The Integration unit shall provide flexibility of adding communication ports (RS485) by adding communication cards, minimum one slot, when required rather than adding additional unit itself. The Integration unit should have inbuilt memory for program storage. The Unit must communicate over TCP/IP with communication speed of 10/100MBPS.25 analytic points license should be included with third party integrator by default. The Integration unit should be capable of handling multiple protocol simultaneously and should not be restricted to single protocol such as Bacnet, Modbus, M-Bus, KNX, SNMP.All integrators should be mandatorily BTL listed.</p>
5.a	Chiller Plant Optimizer on Bacnet IP
5.b	AHU VFD's - 91 Nos.
5.c	LT Panels - Breakers - 20 Nos.
5.d	Energy Meters - 42 Nos.
5.e	UPS - 6 Nos.
5.f	VAV - 200 Nos.
5.g	Solar System 40 Kw - 1 Nos.
5.h	Hydronumatic System - 3 Nos.
5.i	Fire Alarm System - 4000 Devices, 2 Panels
5.j	Lifts / Elevators - 32 Nos.
6.00	SENSORS AND FIELD DEVICES
	Supplying, installing, testing and commissioning of the following sensors / transducers / transmitters
a	DP Switch Air for Fans & Filter Status
b	Air DP Sensor Duct
c	Duct CO2 Sensor
d	DP Switch Water
e	Flame Proof Level Switch for DG Tanks
f	Flame Proof Level Sensor for Main Oil Tank
g	Water Pressure Transmitter
h	Duct Temp Sensor
i	Duct Temp & Humidity Sensor
k	Immersion Sensor
l	Water Level Switch
m	Water Flow Meter for Common Header
7.00	CABLES
a	Supplying, installing, testing and commissioning of 2 Core X 1.0 Sqmm Shielded armoured Flexible Copper Cable (per I/O points hard wired to DDC).
b	Supplying, installing, testing and commissioning of 4 Core X 1.0 Sqmm Shielded armoured Copper Cable (per Soft I/O points to DDC).
c	Supplying, installing, testing and commissioning of Cat6e cable (for networking).

SCHEDULE OF ITEMS FOR BMS WORKS	
S. No.	Description of item
	SUPPLY, INSTALLATION, TESTING, COMMISSIONING & HANDING OVER OF THE FOLLOWING:
8.00	Supply and providing of MS Powder Coated Perforated cable tray complete with all fittings, bends, supports and accessories
a	150mmX50mmX2mm
b	450mmX50mmX2mm
b	300mmX50mmX2mm

LIST OF APPROVED MAKE

HVAC WORKS I/C BMS WORKS**A. LIST OF APPROVED MAKE**

S. No.	Details of Equipment/ Material	Approved Makes / Brands
HVAC WORKS		
1	Chillers	YORK/ CARRIER / DAIKIN/ TRANE (Subject to complying with the technical specifications)
2	Chilled/ Condenser Pumps	Armstrong / Xylem/ Grundfos.
3	Cooling Towers	Baltimore Air coil/ Marley / Evapco/ Paharpur/ Bell/ Delta
5	Tube Cleaning System	Energeo / Ball Tech/ Lyncerv or as per OEM of chiller
6	Humidifier (Ultrasonic)	CAREL / CONDAIR / ARMSTRONG INTERNATIONAL
7	Electro-Chemical Treatment System (Cooling tower)	ENERGEO / LYNCERV / CET-ENVIRO/ ELGRESSY
8	Air Handling Units with Coils etc.	VTS / CARRIER / SYSTEMAIR / FLAKTWOOD/ ZECO/ EDGETECH
9	Heat Recovery & PHE Unit	DRI / Flaktwood / Greenheck/ BRY AIR
10	Enthalpy & Descant Wheel	DRI / Flaktwood / Greenheck/ BRY AIR
11	DX Type Air Cooled Precision Units	Schneider / Vertiv / Swegon Blue Box
12	DX Hi-wall Split AC	Voltas / Carrier / Blue Star / Daikin
12	DX Ductable AC	Voltas / Carrier/ Blue Star / Daikin
12	Air washer	ZECO / VTS / SYSTEMAIR / FLAKTWOOD / IFLOW
13	Fan Coil Unit & Cassette Unit	VTS / CARRIER / SYSTEMAIR / FLAKTWOOD/ ZECO/ EDGETECH
14	Adjustable Frequency Drive/ Automatic AFD Bypass/ Pump Controller/ Differential Pressure Sensor/ Transmitter for Pumps	XYLEM-ITT / GRUNDFOS / ARMSTRONG
15	Air & Dirt Separator	ARMSTRONG/ CALEFFI / OPTIVENT / SPIROTECH/ FLAMCO
16	Centrifugal Fans/Fan section/Plug Fans	VTS/ KRUGER / COMFERI / NICOTRA/ SYSTEMAIR
17	Axial Flow Fans	KRUGER / SYSTEMAIR / GREENHECK / MAICO
18	DRY Scrubber	PureOvyan / Trion / Dencohappel / Rydair/ ZECO/ EDGETECH
19	Inline Fans	Kruger / Nicotra / Greenheck / Ostberg
20	Electronic Air Filtration System	Honeywell / Trion / Pureovyan
21	UVGI (For duct & coil mounted)	KLEANWAVE / Sounuvax / VEP / RUKS
22	CO/CO2 sensor	Belimo / Honeywell / Siemens
23	Anchor/Fastener	Hilti / Fisher/ Rawlplug
24	Duct Support	Gripple / Duct Mate / Durodyne
25	Anti Vibration Mountings	Getzner / Interlasp / Kinetic Noise Control
26	FCU Kit	Caleffi / Oventrop / Herz
27	Pressure independent Control Valve	Belimo / Suater / Azbil / Caleffi
28	Air Distribution (Ducting) GI/GSS Sheets	SAIL / TATA Steel / Jindal

S. No.	Details of Equipment/ Material	Approved Makes / Brands
29	Aluminium Sheet for Ducts	Jindal / Hindalco / Indal
30	Hepa & BIBO	Thermadyne / Spectrum / Camfil / American Air Filter
31	Duct Dampers/ Grills/Diffuser/ VCD/ Collar Damper etc.	Caryaire / Systemair / Ruskin / Iflow/ Glenstorms
32	Propeller Fans	Crompton / Khaitan / Alstom / GE
33	Insulation Adhesive	Pidilite/ Foster/ Henkel / Cisbond
34	Protective Coating over insulation (Lag coating)	Pidilite / Foster / Idendan / Cisbond
35	Automatic Air Vent	Caleffi / Spirotech / Optivent
36	Balancing Valves (Water Duty)	Advance / Audco / L&T
37	Ball valves (With & W/o strainers)	Audco / Advance / L&T
38	Butterfly Valves (Water Duty)	Advance / Audco / L&T
39	Pressure Independent VAV Boxes AHRI Certified	Titus / Trox / Trane
40	Check Valve/Foot Valve/ Sluice Valve/NRV	Advance / Audco / L&T
41	Expansion Tank (closed type)	Xylem-ITT/ Armstrong / Grundfos
42	Motorized Butterfly Valve	Belimo /Danfoss / Siemens
43	Pot Strainer	Emerald / VTM / Rapid Cool
44	Y- Strainer	Zoloto /Audco / Emerald / Rapid cool / Advance / Victaulic
45	Factory Fabricated Duct & Flanges	Zeco / Ductofab / Truestar
46	Fire & Smoke Dampers UL Listed UL555 , UL555S (Actuator- Belimo/Seimens)	Ruskin / Trox / Iflow / Air Flow
47	Fire Dampers UL Listed UL555 , UL555S (Actuator- Belimo/Seimens)	Ruskin / Trox / Iflow/ Air Flow
48	Flexible Duct Connection	Pyroguard / Rolastar / UP Twiga
49	Flexible Pipe Connection	Resistoflex / Easyflex / Diamond/ Dunlop
50	FRP lining for condenser piping	Owen-corning /UP Twiga / Binani
51	GI/ MS Piping (chilled/condenser/drain/hot)	Jindal-Hisar / TATA / SAIL
52	Grooved Couplings & Fittings	Victaulic / Anvil / Smith Cooper
53	Globe/Gate Valve	Audco / Advance / Danfoss / L&T
54	Insulation material	
b)	Polyurethane Foam (PUF) Insulation (pipe Only)	Styrene Packaging & Insulations / Lloyd Insulations / Supreme
c)	Nitrile Rubber /EPDM Insulation with antimicrobial	K-Flex / Superlon / Armacell
d)	XLPE Insulation (For pipes)	K-Flex / Superlon / Armacell/ A-Flex
55	Laminar Flow HEPA tent	Systemair / TROX / American Air Filter / Conaire / Thermadyne / Airtech
56	Magnehelic Gauges	Mitbraus Instruments / Dwyer / Omicron
57	Paints	As per Civil Works Makes
58	Pipe Supports	EASYFLEX / Resistoflex / Diamond
59	Pipe Supports-PUF	Llyod insulation / Melanpur / Beardsell
60	Pressure /Temperature Gauges	H.Guru / Feibig / H.D / BRC
61	Thermostat /Humidistat	Honeywell / Johnson / Siemens /Schneider

S. No.	Details of Equipment/ Material	Approved Makes / Brands
62	Purge Valve/ Drain Valve	Audco / Advance / Anergy / Zoloto
63	PVC /uPVC pipe	Supreme / Astral / Finolex/ AKG
64	Refrigerant Copper Pipes	MANDEV Tubes / Rajco Metal / Mehta Tubes (Max Flow)/ Kwaliti Tubes (Raj State)
65	Room Thermostat	Belimo / Johnson / Siemens / Schneider / Akron
66	RP Tissue	UP Twiga / Styrene Packing or equivalent
67	Strip Heater	Das Pass / Escorts /KEPL or equivalent
68	V Belt	Dunlop/ Fenner / Hilton
69	Variable Frequency Drive	Siemens / ABB / Schneider
70	Water Flow Switch	Honeywell / Danfoss / Belimo
71	Sound Attenuators ASTM E477	Ruskin / Trox / Nailor
72	Fire Retardent Coating	Cischem / Termion / Flamebar /Promat
73	Pre-Insulated Duct (PIR)	Asawa / ALP/ P3
74	VRF/VRV System	Daikin / Mitsubishi/ Carrier
73	Electrical Items	As per Approved Makes of Electrical Works

IBMS SYSTEM

1	Standalone DDCs	SCHNEIDER ELECTRIC STRUXUREWARE / DESIGO BY SIEMENS/ ALC /EBI BY HONEYWELL/ METASYS BY JOHNSON
2	Web Based BMS Software with unlimited user license	SCHNEIDER ELECTRIC STRUXUREWARE / DESIGO BY SIEMENS/ ALC /EBI BY HONEYWELL/ METASYS BY JOHNSON
3	Web Based Router/ Network Area Controller	SCHNEIDER ELECTRIC STRUXUREWARE / DESIGO BY SIEMENS/ ALC /EBI BY HONEYWELL/ METASYS BY JOHNSON
4	Power & Energy Management Software.	Honeywell/ Siemens/ Johnson Controls / Schneider Electric/ ALC
5	Duct Temperature Sensor	Honeywell/ Siemens/ Johnson Controls / Schneider Electric / Belimo
6	Immersion Temperature Sensor	Honeywell/ Siemens/ Johnson Controls/ Schneider Electric / Belimo
7	Room Temperature Sensor	Honeywell/ Siemens/ Johnson Controls/ Schneider Electric / Belimo
8	Duct Humidity Sensor	Honeywell/ Siemens/ Johnson Controls/ Schneider Electric / Belimo
9	Room Humidity Sensor	Honeywell/ Siemens/ Johnson Controls/ Schneider Electric / Belimo
10	Flow Meter	Honeywell / Kampstrup / Belimo/ Omicron
11	Duct Static Pressure Sensor	Honeywell/ Siemens / Johnson Controls / Schneider Electric / Belimo
12	Water Level Switch	Veksler / Filpro / Sontay / Belimo/ Omicron
13	DP Switch – Water	Honeywell/ Siemens / Johnson Controls / Schneider Electric / Belimo

S. No.	Details of Equipment/ Material	Approved Makes / Brands
14	DP Switch – Air	Honeywell/ Siemens / Johnson Controls / Schneider Electric / Belimo/ Omicron
15	IAQ	Honeywell/ Siemens/ Johnson Controls / Schneider Electric / Belimo
16	Water Flow Switch	Honeywell/ Siemens/ Johnson Controls / Schneider Electric / Belimo/ Omicron
17	Pressure Transmitter – Water	Honeywell/ Siemens/ Johnson Controls / Schneider Electric / Belimo/ Omicron
18	Current Relay	Veris / Seto / Mamac / Omron/ ABB/ Omicron
19	Voltage/ Current/ Power Factor Transducer	ABB/ L&T/ Enercon/ SETCO/ Situ/ Omicron
20	Flame Proof Level Switch / Level Transmitter	Veksler / Filpro / Sontay / Techtrol / Omicron
21	PH Sensor / TDS Sensor	Honeywell/ Hach/ Greisinger / Shenitech / Omicron
22	Personal Computer and Servers	HP/ DELL/ LENOVO
23	Colour Monitor	DELL (ULTRA SHARP)/ HP (PAVILION)/ SAMSUNG (SYNC MASTER)/ LG (FLATRON)/ LENOVO
24	Printer	HP/ EPSON/ CANON
25	Copper Conductor Control Cable	As per Approved Makes of Electrical Works
26	Communication Cables / Signal Cable	As per Approved Makes of Electrical Works
27	LAN cables for BMS Network	As per Approved Makes of Electrical Works
28	PVC Conduits	As per Approved Makes of Electrical Works
29	Network Switches	As per Approved Makes of Electrical Works
30	Racks & Other Accessories	As per Approved Makes of Electrical Works

PART 4

NURSE CALL SYSTEM, MGPS & MEDICAL SERVICES

**SCOPE OF WORKS, PARTICULAR SPECIFICATIONS, SCHEDULE
OF ITEMS AND LIST OF APPROVED MAKES**

Scope of Work

Nurse Call System (NCS)

Bidder shall execute all ancillary works as maybe required for complete installation and trouble-free functioning as a part of the "turnkey work". The scope of work for installation of Nurse Call System (NCS) consists of supply, installation, Testing and commissioning of:

1. Main Controllers/ IP Controllers /System switch
2. Nurse Station Terminal
3. External Large LCD Display at Nurse Station or Corridors Display
4. Patient Handset without voice facility with Connection Module/ Bed Head Unit – for Wards/ Multiple bedded rooms
5. Patient call-cancel button with handset
6. Pull cord unit for WC/ Bath area.
7. Lamp Module/ Zone Light/ Directional Light: Outside room/ ward
8. Doctor Call & Cancel Button (Code Blue):
9. Nurse Call Server
10. Backbone / Network switches
11. IT racks or any other infra required for the satisfactory installation, commissioning and functioning of the system.
12. All Conduiting and wiring necessary for functioning of the system as per relevant code.
13. Central Monitoring Station with event database software
14. Integration with hospital LAN/ BMS
15. The complete system must satisfy the criteria of the standards UL/ VDE0834 part 1 and part 2 in full that apply for call systems and all other standards and regulations
16. Must supply a valid certificate obtained from an independent and accredited testing centre for satisfactory installation of system as per standard.
17. Final electrical safety test, system test, and calibration should be done as per standards.

Particular Specifications

NURSE CALL SYSTEM (NCS):

General Information:

The complete system must satisfy the criteria of the standards UL/ VDE0834 part 1 and part 2 in full that apply for call systems and all other standards and regulations mentioned therein. As proof of this, the issuing party must supply on request a valid certificate obtained from an independent and accredited testing centre.

A typical IP based NCS essentially consist of the following. There can be more add on units in advanced systems. Since this specification is for a basic NCS, particular specifications for the following are provided:

1. Main Controllers/ IP Controllers /System switch
2. Nurse Station Terminal
3. External Large LCD Display at Nurse Station or Corridors Display
4. Patient Handset without voice facility with Connection Module/ Bed Head Unit – for Wards/ Multiple bedded rooms:
5. Patient call-cancel button with handset
6. Pull cord unit for WC/ Bath area.
7. Lamp Module/ Zone Light/ Directional Light: Outside room/ ward
8. Doctor Call & Cancel Button (Code Blue):
9. Nurse Call Server
10. Backbone / Network switches
11. Central Monitoring Station with event database software
12. Integration with hospital LAN/ BMS

1. MAIN CONTROLLERS / IP CONTROLLERS / SYSTEM SWITCH:

The controller shall be IP based & all the nurse station/ patient handsets & other equipment shall be connected to the main controller through a CAT 6 cable through the RJ45 connection port. Main controllers shall be networkable with other controllers. A fault in one controller shall not have an effect on the working of another controller. Each controller shall be able to work independently in case of a problem in the network. Apart from the controller, other devices in the room/ toilet/ outside room/ nurse station/Lamp module shall be POE-based. The controller shall be wall-mounted or rack-mounted as per site requirements. For decentralised operations, one controller shall not be connected to more than 20 Rooms/ 30 beds.

2. NURSE STATION TERMINAL:

The nurse station shall be IP-based and have a large LC display minimum of 6" (Minimum 4 calls can be displayed at a time in LC display) capable of showing multiple patient calls at a time with bed/ ward no. & type of call. There shall be scroll-down feature as well in case no. of patient call increase at a given time i.e. there shall not be any chance of missing any patient call.

There shall be a feature to priorities patient calls depending on the patient's condition, type of call & location (Bed or WC). The nurse station shall have a voice facility.

It shall be user friendly & have good aesthetic looks. All Nurse Stations shall be networked with other nurse stations with the facility of call forwarding/ diverting/ escalating calls between nurse stations.

Nurse stations shall be programmable so that emergency calls shall always be on top priority. Nurse Station shall have an inbuilt sounder having volume & tone adjustment. The nurse station shall have other settings also like brightness control, multiple tones to adjust tone as per the type of call, fault or failure indication, etc. It must be POE-based & shall not require a separate power cable/ power supply. The important functions are:

- Displays date and time.
- Permanent indication of the number of calls, reminders, and occurring faults, outstanding at the time.
- Displays all presences that are marked, depending on staff category listed on a desk (in the corresponding colours in accordance with VDE 0834/ UL/ Health Technical Memorandum 08-03: Bedhead services-based nurses call systems and with a unique symbol).
- Displays all calls with their relevant colours in accordance with VDE 0834/ UL/ Health Technical Memorandum 08-03: Bed head services-based nurses call systems and clear symbols for each type of call,
- The following information must be able to be imparted in this case: the exact type of call with information about the bed number or WC call, doctor call, etc. the exact call location with information about the individual room name and the care group to which it might have been assigned to.
- All call indications are automatically show in accordance with the priorities for indication which are stored in the system, starting with the highest priority call:
 - For calls across more than one ward the relevant ward name must also be indicated.
 - Emergency calls must always be shown flashing,
 - Colour graphic LC display, for displaying all details.
 - Integrated SIP VOIP telephone
 - Microphone and loudspeaker for hands-free speaking (incl. volume adjustment)

3. EXTERNAL LARGE LCD DISPLAY AT NURSE STATION OR CORRIDORS DISPLAY:

For the large nurse station counter, there shall be an external LCD/ LED connected with the nurse call system to display the calls on an external larger screen of a minimum 32" so that nursing staff can see the incoming calls including details like type of calls, bed no., ward, etc. from long distance.

The monitor may be mounted on the wall or hung from the ceiling using standard accessories as per site requirements. The external monitors are standard monitors & existing monitors in the hospital can be used subject to compatibility of input/output ports etc.

4. PATIENT HANDSET WITHOUT VOICE FACILITY WITH CONNECTION MODULE/ BED HEAD UNIT – FOR WARDS/ MULTIPLE BEDDED ROOMS:

Patient handset shall be directly on IP, Patient handset shall be connected whenever the patient needs the attention of any "Nurse", the patient just presses the button provided at his/ her bedside. On pressing the button, the alarm shall be enunciated at the Nurse Station informing the nursing staff about bed no. / Room no. along with the type of call (Bed call WC call or Doctor Call) for their necessary action. The patient handset shall have a call button (red color button/indication

with nurse symbol) and shall be connected to the bed head unit through a plug-in cable. The patient handset shall have a connection cord to connect with the connection module. For safety reasons, the handset shall have an antimicrobial/ antifungal coating to avoid infection transfer, shall be shock & spill proof & have a suitable color & symbol for the nurse call button on the handset. The finder light & reassurance light should be available on the patient's handset.

5. PATIENT CALL-CANCEL BUTTON:

Patient call cancel button with membrane keypad consisting of-

- 1 call button (red with nurse symbol) including a finder/reassurance light,
- 1 presence key (green) with a control LED
- 2RJ45 sockets for connecting the data circuits including a mounting frame for screw less Attachment to an installation case.

6. PULL CORD CALL BUTTON FOR WC:

There shall be a nurse call button with a suitable length (min. 2.8 meters) of pull cord with color/ symbol for nurse call from the toilet. It shall be installed above the shower head preferably in such a way to access from the bath area as well as the WC. The pull cord shall be detachable & replaceable without changing the unit for hygiene reasons. The buttons shall be moisture-protected & suitable for bath areas.

Interfaces/system connection: 2 × RJ-45 sockets for connection

- Protection class: IP 44, VDE 0834 Environmental class II
- Intended for use in wet rooms.
- Integrated locating and reassurance light
- Actuating the pull cord has the same effect as pressing a call button (red)
- Fast exchange pull cord (approx. two meters) with snap hook
- Red grip with nurse symbol
- Germ inhibiting membrane keypad

7. LAMP MODULE:

Lamp module shall be POE based, shall not require separate power cable/ power supply & installed outside the room/ ward above the door for visual indication of different type of call. There shall be 5 different colour (white, red, blue, yellow, green) section in the lamp module for indication of different type of calls.

Once the patient annunciates the alarm, the signal shall go to the nurse station. The lamp Outside the patient room/ ward shall also glow simultaneously red providing a visual alarm. Lamp shall have different colours light to inform about the type of call like red light for bed call, blue light for code blue call, green light for nurse presence, white light for WC call, and yellow light for other services.

- Lighting intensity: max. 2500
- Brightness: Lux 250 cd per m to 750 cd per m
- Interfaces/system connection: 2 × RJ-45 sockets for connection

8. DOCTOR CALL & CANCEL BUTTON (CODE BLUE):

Each ward/ room shall have one code blue button (Doctor Call) having doctor call & doctor presence & Doctor call cancellation button. Doctor call button shall be used only by nurse staff &

programmed in such a way to avoid direct code blue call by patient. It shall be a separate programmable button with presence & cancel button.

It shall not be in patient handset with nurse call button & shall have separate presence & cancel Button. Once nurse press code blue button, call shall go to every nurse station of the hospital or as programmed as per site requirements with room no. & bed no.

Information so that code blue team available at any nurse station shall be informed & they can reach the patient room on immediate basis.

- Interfaces/system connection: 2 × RJ-45 sockets for connection
- Protection class: IsP 44, VDE 0834 Environmental class II

9. NURSE CALL SERVER:

Server used during the commissioning of the system for reading in the system topology, for uploading the firmware and the system configuration, for operating interfaces to foreign systems, for logging of all system events and as a central location for system configuration and remote maintenance. The system may consist of (As per OEM design to ensure the smooth running of system with all the functionalities defined in this document):

- All necessary software and hardware for handling the complete nurse call system and all beds call points. It should support the redundant architecture as a optional feature
- 1 x 1000 base -TX LAN port for connecting in to Customer LAN Network
- 1 x 1000 base - TX LAN Port as a back-end service port
- It should support the additional mini server architecture if system has a more than 1 VLAN
- 4 x 1000 base -TX LAN ports for further extending the Nurse Call Network-Pre-soaked System Software
- 2 x DB 9 serial connection for Interface
- 2 x USB Ports
- Three status LEDs serve for indication of the operative states. A reset button is also located on the front.
- Suited for 19 inch 1 HE/HU Network Rack Size.

10. BACKBONE / NETWORK SWITCHES:

This switch is used to connect the system server to the communications network, for connecting all the other servers and foreign systems to be connected to the network, which exchange data with the network via an IP interface. Furthermore, backbone switches are also to be used for bridging large distances between the individual servers, foreign systems and peripheral modules. General requirements for all the types should be as per manufacturer recommendation and it should be minimum layer 2/ 3 Switch with DTP and VLAN trunking layer 2 protocol.

The system shall be able to use hospital existing backbone switches also or same make as other hospital backbone switches to have better warranty & maintenance support.

11. CENTRAL MONITORING STATION WITH EVENT DATABASE SOFTWARE:

Complete nurse call system shall be centrally connected to a PC having a software recording of all the different type of call & cancel with date & time. The vendor needs to consider server/ back bone / network switches etc. As the nurse call system is on IP, it should work on client existing LAN infrastructure as well, if required without any additional charges/ software/ license. However,

servers for nurse call system shall be supplied & configured by the OEM only. The software shall record the date & time of call generated by patient & call presence & cancel by nurse with type of call. Software shall be able to generate report on real time basis as per requirement. It shall also be possible to put reminder/ highlighted on calls if nursing staff do not attend/ cancel the patient call with in specific time decided by the hospital management. The fault in central monitoring station shall not affect the working of nurse call system in the hospital. The software shall show the pin point address & location of any fault in the system like any fault in cable or any nurse call module. The software shall be for life time & there shall not be any separate license charges later on.

12. INTEGRATION WITH hospital LAN & BMS:

The nurse call system shall be integrated with hospital LAN & BMS through IP protocol.

The following types of calls, correspond to the basic priorities and responsibilities mentioned:

- (a) Bathroom or WC emergency call > Nurse
- (b) Room emergency call > Nurse
- (c) Bed emergency call > Nurse
- (d) Enhanced patient call from his bed or disconnection call > Nurse
- (e) Fault > House Technician
- (f)** Failure > House Technician

Bathroom or WC emergency call

This is a call made by a nurse from a sanitary room (WC, shower etc.) with marked presence. The call cannot be queried and must be followed up by the nurse directly. The call is to be signalled using a flashing light and an acoustic signal with a fast call rhythm. Furthermore, all system displays must recognise this call as such in an unambiguous manner and must make details known about the room in question. The call can be cancelled either using a separate cancellation button or by using the accompanying presence button at the communications terminal.

Room Emergency Call

This is an emergency call made by a nurse from a room within the ward. The call is made where nurse presence has been marked on the communications terminal and is indicated optically and acoustically on other terminals where nurse presence is marked (with information on the display about the precise call location). The call is to be signaled using a flashing light and an acoustic signal with a fast call rhythm (emergency call conforming to VDE0384). If required, it is also possible for this call to be queried. The room emergency call can either be cancelled by pressing the nurse presence key at the terminal from which the call was triggered or by remotely cancelling the call once a call query has taken place. Once this call has been queried, it must also be possible for a reminder to be activated.

Bed Emergency Call

This is an emergency call made by a nurse from a patient bed. The call is made where nurse presence has been marked on the communications terminal and is indicated optically and acoustically on other terminals where nurse presence is marked (with information on the display about the precise call location including bed number). The call is to be signaled using a flashing light and an acoustic signal with a fast call rhythm (emergency call conforming to VDE0384). If required, it is also possible for this call to be queried. The bed emergency call can either be cancelled by pressing the doctor presence key at the terminal from which the call was triggered or

by remotely cancelling the call once a call query has taken place. Once this call has been queried, it must also be possible for a reminder to be activated.

Enhanced Patient Call

This is a call made a patient from their bed who is severely ill or has just undergone an operation. This call is indicated at other terminals with nurse presence set both optically on the display (with information about the precise call location including bed number) and acoustically. The call is to be signaled using a red light and an acoustic Signal with a normal call rhythm. If required, it is also possible for this call to be queried.

It must also be possible for reminder to be activate. The ward sister is responsible for making the decision to upgrade individual patients, with the programming being carried out via the ward terminal or the control panel. This type of call has a higher priority than standard patient calls.

Fault Message

The fault message is automatically detected by the communications system in the event of wire breaks or similar events and is indicated immediately on all ward terminals and control panels that are configured and can be reached, both optically and acoustically, as well as being forwarded to other systems such as mobile end devices, central management systems or alarm servers via various interfaces. The optical messages on the display must contact pertinent information, from which it is possible to ascertain the approximate location of the fault. This message is cancelled once the fault itself has been dealt with, however it is possible to suppress the acoustic indication for a configured period after pressing a key on the staff or ward terminal.

Failure Message

The fault message is automatically detected by the communications system in the event of wire breaks or similar events and is indicated immediately on all ward terminals and control panels that are configured and can be reached, both optically and acoustically, as well as being forwarded to other systems such as DECT systems, central management systems or alarm servers via various interfaces. The optical messages on the display must contact pertinent information, from which it is possible to ascertain the approximate location of the failure. This message is cancelled once the failure itself has been dealt with, however it is possible to suppress the acoustic indication for a configured period after pressing a key on the staff or ward terminal.

Call Handling at the Staff or Ward Terminal

Call queries must be carried out on a room-by-room basis down to the patient handsets. The nurse must be able to be receive one call after the other in accordance with the priority of the calls as well as in a free order.

Each call is instantly marked as being query able or not query able. To optimise the operating procedure, the relevant information must be shown as plain text on the display using different colors and symbol.

After the call has been queried, a speech connection must be established to the caller, which is indicated by means of a brief acoustic attention signal to both parties in the conversation. Additionally the precise call location must be indicated. After the conversation has been ended, each call can be remotely cancelled or be replaced by a reminder.

Automatic Call Forwarding

If calls have not been able to be dealt with within a pre-configured time because staff members are all busy, it must be possible to forward a call to one or more other pre-configured care groups.

This must continue to take place until all calls have been dealt with. All other functions are identical to those for manual interconnection.

Variable Assignment of Rooms and Wards

During the commissioning process of the communications system, it is configured which end devices are functionally assigned to which room or to which ward. Logical units, such as rooms, sanitary rooms, wards, stores etc. are formed regardless of their physical structure by various software parameters. It must also be possible to carry out this varying assignment of individual rooms to the wards by the nursing staff during operation. Consequently, the programming of "group nursing" is easily possible. In addition, rooms can be integrated from neighboring wards if they are empty or overly full, or a room can be transferred to another ward.

Testing and Service Function

In accordance with the standards listed at the beginning of this document, all system devices must be automatically monitored to check that they are functioning reliably. Errors detected by the system must be indicated on the ward terminal or control panel as either "failures" or "faults" depending on their cause.

Devices and parts of the system that are not affected must continue to function without their functioning being impeded. Test functions which can be carried out at any time, for displays, LEDs, and sounders, must allow the problem-free testing of these system components. In such events, additional information can be queried from the communications terminals, which also further errors to be kept to a minimum.

Regulated Call Forwarding

The querying of a call must cause it to be no longer display on other system devices, will new calls being displayed immediately when they occur. A conversation may neither be influenced nor terminated from another location. It is also not permissible to listen in on conversations.

Automatic Call Termination

To avoid speech circuits getting blocked, patient calls are to be terminated after a specific time. A conversation automatically cancels the call, even when someone forgets to cancel the call at the end of the conversation.

Backing Up of Data

The memory modules of the system computer must be able to save its current state of information in the event of a power failure for an unlimited period, and to transmit it once the power returns. If there is a power cut during a conversation, then the affected room is to be marked with a reminder when the power returns.

Please note the following important point from operational/ functional point. Vendor has to provide this feature as inbuilt or using additional module, if require.

1. The nurse call system is life safety system and must be approved in accordance with VDE0834/ UL to ensure that product is meeting & in compliance with international standard applicable for hospital environment.
2. The complete system design shall be decentralised system. It must not happen that any fault in any component like server, software, controller etc. causes the working of nurse call system in complete hospital. A hospital cannot afford that the complete nurse call system shut down due to fault in one component. For this, each controller should not be connected with more than 30 beds.

3. There shall be particular color of button for nurse call, nurse presence/ cancel, code blue so that it is easy for patient/ hospital staff to understand easily.
4. The patient handset shall have antimicrobial/ antifungal coating. The infection from one patient to another patient/ attended/ hospital staff is concern in hospital and need to put safety at every level.
5. Code blue/ additional nurse requirement shall be programmed in such a way that patient shall not be able to activate themselves. Only nursing staff should be able to activate it using programmable nurse presence button.
6. There shall be no nurse presence/cancel or code blue button on patient handset. It shall be separate button. Patient handset shall have nurse call button only.
7. Additional nurse help request button (Emergency Call) shall be available on each bed either inbuilt programmable or external and shall be locked with nurse presence to avoid any false emergency calls by patient.
8. The patient handset without voice with necessary call button, call cancel button should not be on patient handset.
9. Since the complete system is on IP, it should also work with hospital existing LAN infrastructure.
10. All the 2-way Speech devices e.g. Nurse Station, Room Terminals, Patient handset with speech must use VOIP technology and must be IP based.
11. In case of failure of Controller not more than 15 Rooms/ 30 beds should be affected.
12. The controller must use the VOIP protocol for speech connection. The analogue audio line is not allowed in controller which support Voice / Speech line.
13. The physical Server for controlling and handling of system is must. Any kind of Virtualization software is not allowed.
13. There shall be reassurance light in patient handset & bed head unit to inform patient that call has been generated.
15. Each patient handset shall be provided with cradle (bracket) and clips also. Cradle (Bracket) shall be used to keep handset when not in use and clips shall be used to hold handset with bed or any other equipment to avoid damage of patient handset due to fall of handset.
16. The patient handset shall be spill & shock proof to avoid damage of handset due to fall of water/ food by the patient and for patient safety.
13. If someone pull the patient handset cord with high pressure, it should not damage the handset & bed head unit. The patient handset should be disconnected and disconnection call should be initiated. It will help to reduce the maintenance cost and avoid theft of patient handset.
17. There shall be no license fee for any software. The software provided shall be provided for lifetime.
18. The OEM authorisation certificate (not through their dealer) must be provided by the vendor for the specific project.

19. The OEM should also submit certificate that 3 nos. operational training shall be provided directly by OEM (not through their dealer/ vendor) as per client requirement on site to hospital staff without any additional cost.
20. The OEM should also submit the organizational chart with contact details of the concerned person in India to be contacted for required support during execution/ training or after-sales services.
21. OEM must have their office in India along with the technical support team to provide necessary product & after-sales support or to escalate any issue, if required.
22. The bidder needs to consider any additional item required to complete the nurse call system as per the system offered by them.

SCHEDULE OF ITEMS - NURSE CALLING SYSEM

Sl. No.	DESCRIPTION
	Design, supply, installation, testing and commissioning of Nurse Call System. The system should be UL/ VDE0834 approved. Bidder need to submit certificate with model no. for each item as follows:
1.0	Supply, Installation testing & commissioning of UL/ VDE 0834 certified/ approved System Switch/ Controller:
	<p>The system switch/ controller forms a decentralised communications node for exchanging data between the connected system devices and the rest of the communications system, consisting of :</p> <ul style="list-style-type: none"> - 1 x RJ45 socket, 100Mb IP Port (IEEE802.3 100BaseTX), galvanically isolated conforming to EN 60950 and VDE 0834; - 7 x RJ45 sockets, each for a 100Mb IP system port (IEEE802.3 100BaseTX) for connecting all IP capable system modules; - 1 x RJ45 socket, 100Mb IP Port (IEEE802.3 100BaseTX) for connecting communications, staff and ward terminals as well as control panel PCs or for redundant Connection. - Control LEDs for indicating the current operating state; - 2 x RJ45 sockets for connection of the external data bus; - All IP system modules are supplied with power using Power over LAN technology;
2.0	Supply, Installation testing & commissioning of UL/ VDE 0834 certified/ approved Nurse Station Terminal
	<p>Nurse Station shall comprise of minimum 7" large touch screen LC color graphic display for displaying all details, a smash-proof glass panel (to protect the sensitive display from unnecessary contact during cleaning and other processes), a Querying receiver for speaking discretely, Microphone and loudspeaker for hands-free speech (incl. volume control), automatic changeover between hands-free and discrete speaking, Electronic circuit board with controller and Flash Prom, 100BaseTX interface to the system switch, PC interface to the communications control panel, 2.8m connection cable with an RJ45 connection plug, which is protected, from disconnection, for connecting to a connection module. The ward terminal shall display the date and time, an indication of all presence, all set reminders, indication of all calls in accordance with VDE0834/ UL. All call indications follow the priority and must display the exact location of the calls. The ward terminal shall be provided along with a suitable connection module & back box.</p>
3.0	Supply and fixing of External Monitor - To display call generation on external bigger display
	32" LED monitor with mounting accessories having DVI/ HDMI port. Make: LG, HP, Samsung
	DVI / HDMI output to display nurse call on external monitor (In case DVI input not available in external monitor, DVI to HDMI convertor may be used for HDMI output)
4.0	Supply, Installation testing & commissioning of UL/ VDE 0834 certified/ approved Patient Handset - Without Speech
	<p>Consisting of a plastic case in antimicrobial finish having:</p> <ul style="list-style-type: none"> - Call button with nurse symbol with integrated finder and reassurance light on the top end of the unit, - Membrane keypad in antimicrobial/ anti fungal finish with integrated LEDS for operation, consisting of: <ul style="list-style-type: none"> - 2 call key, - 2 lighting keys - 2.80 metre connection cable with auto-disconnecting RJ45 connector plug. <p>It shall be supplied with cradle for holding patient terminals & necessary connection module.</p>

5.0	Supply, Installation testing & commissioning of UL/ VDE 0834 certified/ approved Bed Head Unit for Patient Terminal
	Connection module for patient handset shall consist of:- 1 x RJ45 socket marked in color and with measures to ensure that the push button is correctly connected, including auto disconnect mechanism,- 1 membrane keypad with:- 1 call button (red with nurse symbol) including a finder / reassurance light,- 1 presence key/ cancel button (green) including a control LED,- 1 DIN Socket for interfacing with other medical devices especially in ICU/ HDU or rooms where other medical devices are available & to be interfaced for automatic call generation- should be connected in loop technology.
6.0	Supply, Installation testing & commissioning of UL/ VDE 0834 certified / approved Pull Cord Button without cancel button - same as 9.0 however without cancel button.
6.1	Supply, Installation testing & commissioning of UL/ VDE 0834 certified/ approved Common Cancel button for wards WC/ shower area.
	1 cancel key (Green) including a finder light / reassurance light, - a membrane keypad -2 RJ45 ports for loop connectivity - should be connected in loop technology.
7.0	Supply, Installation testing & commissioning of VDE 0834 certified/ approved Loop Powered Lamp Module. Shall be freely programmable as zone indicator & directional light as per site requirement
	POE based - For optical indication of calls, presences and reminders in the relevant colours conforming to VDE0834 consisting of: - 5 light chambers with light reflectors for homogeneous illumination, - 2 RJ45 ports for loop connectivity - the LED life expectancy is approximately 100,000 operating hours, - should be connected in loop technology. Separate power cable shall not be required.
8.0	Supply, Installation testing & commissioning of UL/ VDE 0834 certified/ approved Code Blue button for ward having nurse station outside wards
	1 doctor call (Blue) including a finder light / reassurance light, - a membrane keypad
9.0	Supply, Installation testing & commissioning of Management centre - Nurse Call Server
	Management Centre Server for Nurse Call System for uploading the firmware and the system configuration, for operating interfaces to foreign systems, for logging of all system events and as a central location for system configuration and remote maintenance as per VDE 0834 - Intel Xeon 3220 2,4GHz or similar - 16 GB RAM, 1 x 160GB HDD - 1 x DVD hard drive, 2 x Gbit LAN Ethernet RJ45 - 1 x serial connection RS232 and 2 x USBV2.0 - 1 x PCI or 1 x PICE socket, support for SUSE Linux enterprise Server from V10.1
10.0	Supply, Installation testing & commissioning of UL/ VDE 0834 certified/ approved Backbone Switch:
	This switch is used to connect the system server to the communications network, for connecting all the other servers and foreign systems to be connected to the network, which exchange data with the network via an IP interface. Furthermore, backbone switches are also to be used for bridging large distances between the individual servers, foreign systems and peripheral modules. General requirements for all the types should be as per manufacturer recommendation and it should be minimum layer 2/ 3 Switch with DTP and VLAN trunking layer 2 protocol.
11.0	Supply, installation and configuration of Software- Event Database Software, Networking & Integration

	Software pack installed on the system server for automatically logging all events in the entire communications system, such as, e.g., calls, presence markings, call acknowledgements, reminders.
12.0	Supply, Installation testing & commissioning of UL/ VDE certified/ approved Small Nurse Station Terminal
13.0	Cable, Conduit & accessories
13.1	Supply and laying including termination of cabling in existing conduits including terminations (RJ45):
	Supplying and laying of UTP 4 pair 23 AWG CAT 6 LAN Cable in the existing surface/ recessed steel/ PVC conduit as required. 4 Pair CAT6 Unshielded, Twisted Pair (U/UTP) Cable 305 mtr per Box. Blue/ Orange/ White/ Green in colour conforming to the following standards like ANSI/TIA 568 C.2, EN50173, IEC 11801 2nd ED, frequency tested upto 700Mhz in the existing surface/ recessed steel/ conduit as required.
14.0	Supply & laying of ISI marked 25 mm conduit with accessories
	Providing and fixing in position of GI conduit including bends, junction boxes, pull boxes, GI pull wire including necessary civil work such as chase cutting, chipping, making good for recessed conduiting or clamping on surface with saddles, clamps etc. for surface conduiting - 25mm dia, 16G GI conduit.

Note : The schedule of items mentioned above are indicative and not exhaustive, Any item not stated under this section but shown in the GFC drawings / Particular specifications shall deemed to be included under the scope of this item.

List Of Makes for Nurse Call System		
S. No.	Item Description	Makes
1	Nurse Call System	Hampton / Schrack Seconet/ Rauland / ZKR / Austco/Norris/Baid Power
2	Monitor	LG / Samsung/ Sony
3	MS / GI Conduits & Accessories	As per approved makes in ELV/ Electrical section
4	CAT6 Cables	As per approved makes in ELV section

Scope of Work

MEDICAL GAS PIPELINE SYSTEM (MGPS):

Bidder shall execute all ancillary works as maybe required for complete installation and trouble-free functioning as a part of the "turnkey work". The scope of work for installation of Medical Gas Pipeline System consists of supply, installation Testing and commissioning of:

1. Oxygen/ Nitrous Oxide/ Carbon dioxide manifold with automatic control panel and emergency manifold for each of the services,
2. Vacuum (suction) supply system,
3. Medical and Surgical Air supply system (4 bar & 7 bar),
4. Control panel for Vacuum system and Air plant system
5. Distribution piping with accessories,
6. Master Alarm, Area alarm,
7. Bed Head Units/ Pendants, Terminal units/Gas outlets,
8. Anesthesia Gas scavenging system (AGSS),
9. Ward & theatre vacuum unit,
10. Flow meter and Isolation Valve
11. Satisfactory installation and integration of complete MGPS as per HTM02-01/NFPA99C /DIN/EN/ISO-7396-1 standards for all beds including Emergency, Day Care area, Critical areas, OT, NICU/PICU, diagnostic areas and ward areas to fulfil the hospital operating requirement and as per Standard and Client requirement.
12. Although liquid medical oxygen plant along with vaporisers shall be procured by AAHII at a later stage but all the pre- requirements to install it such as PCC/ RCC platform, fencing, pressure reducing stations, control panel for LMO, distribution piping and any other service required for the integration shall be in the scope of the MGPS executing agency and hence in the scope of this tender.
13. Accommodation for manifold and plant room shall be as per standards with at least two-hour fire rating.
14. Final electrical safety test, system test, and calibration should be done as per standards.

Particular Specifications

MEDICAL GAS PIPELINE SYSTEM PARTICULAR SPECIFICATION (MGPS)

Bidder shall execute all ancillary works as maybe required for complete installation and trouble-free functioning as a part of the "turnkey work". Bidder shall be responsible for design, supply, installation, testing and commissioning of medical gas supply system in coordination with the client.

The bidder shall be responsible for the complete works including the submission of working Drawings, detailed work schedule and materials.

Detailed Specifications

OXYGEN SUPPLY SYSTEM Oxygen Manifold – 4 X (10 + 10) (Secondary)

Manifold shall consist of two high pressure header bar assemblies to facilitate connection of 80 nos of secondary cylinder supplies. Each header bar shall be provided with required numbers of cylinder pigtail connections to suit cylinder valves as per incorporating a check valve at the header connection. The high-pressure header bar shall be designed in such a manner that it can be extended to facilitate additional cylinder connections. Each header bar assembly shall be provided with a high pressure shut off valve. The manifold should be so designed that it shall suit easy cylinder changing and positioning. The system should have non – return valves for easy changing of cylinders without closing the bank along with individual cylinder valve and pressure relief valve. The cylinder should be placed with the help of cylinder brackets and fixing chains which should be galvanized.

Emergency Oxygen Manifold – 2 X (10 + 10)

Emergency Manifold shall consist of two high pressure header bar assemblies to facilitate connection of 40 nos of secondary cylinder supplies. Each header bar shall be provided with required numbers of cylinder pigtail connections to suit cylinder valves as per incorporating a check valve at the header connection. The high-pressure header bar shall be designed in such a manner that it can be extended to facilitate additional cylinder connections. Each header bar assembly shall be provided with a high pressure shut off valve. The manifold should be so designed that it shall suit easy cylinder changing and positioning. The system should have non – return valves for easy changing of cylinders without closing the bank along with individual cylinder valve and pressure relief valve. The cylinder should be placed with the help of cylinder brackets and fixing chains which should be galvanized.

Fully Automatic Oxygen Control Panel:

Automatic control panel should be constructed in accordance with the requirement of standards.

The fully automatic oxygen control panel should comply with HTM 02-01/DIN/EN/ISO.

The manifold assembly should provide two stages of pressure regulation. A single stage primary regulator, one for each cylinder bank should be used to initially reduce cylinder pressure and two single stage pressure regulators should be provided in the control cabinet for final delivery pressure regulation. One delivery pressure regulator in service and one should be ready for service in a standby mode. The Manifold control panel should be digital, fully automatic type and switches from "Bank in Use" to "Reserve bank" without fluctuation in delivery supply line pressure. Changeover should be performed by pneumatically operated valves contained in the control cabinet. In the event of an electrical power failure the valves should automatically open to provide an uninterrupted gas flow. It should be 100% automatic and should not require manual adjustment.

The automatic gas manifold control should include:

- Supply pressure gauges x 2nos
- Delivery pressure gauge x 1no
- Line pressure regulators with bypass valve x 2nos
- Line pressure relief valve x 1no
- Green in service led indicators, one for each supply bank x 2nos
- Amber / yellow ready for service led indicators, one for each supply valve x 2nos
- Red LEDs to indicate depleted cylinders, one for each supply bank x 2nos
- Instruction for changing the cylinders should be clearly identified on the front of the control panel.

All functional components should be enclosed in corrosion resistant robust material.

All components inside the Control Panel like Pressure Regulators, piping and control switching equipment should be cleaned for Oxygen Service and installed inside the cabinet to minimize tampering with the regulators or switch settings.

The Control Panel shall include two pressure relief valves, one high pressure approx.200psi and one low pressure approx.75 psi.

The heavy-duty control panel should be provided with a flow capacity of 2000 LPM at 50 to 60 psi.

GAS OUTLETS /TERMINAL UNITS

Terminal Units (Gas Outlets) with probes/Adaptors for O₂, N₂O, Compressed Air (4) Surgical Air-7, Vacuum, Carbon Dioxide.

The Medical gas outlets shall conform to HTM 02-01/EN/ISO/DIN.

Front Loading Type Terminal Outlets should be designed to dispense medical gases (or an inlet for medical vacuum) to the secondary equipment (flow meters, Suction regulators, etc.) at the point of use and is gas specific so that secondary devices cannot be "attached" to the wrong gas. When not in use the gas in a nonflowing state within the Outlet (Terminal unit) sealed by "O" ring. The adapter when inserted pushes the poppet inside and the gas starts flowing and sealing is ensured by the "O" ring or a seat. The Outlets are Quick Connect Type and gas specificity is accomplished by "Pin indexing." The outlets should have following features:

- Push to insert and press-to-release mechanism for probes.
- Allows plugging of probes from front.
- Self-sealing valve on disengaging the probe (Quick disconnect)
- Smooth quiet action.
- Non return valve for on line servicing/ repairing
- Indexed to eliminate inter-changeability of gas services
- Color-coded gas specific front plate
- Flow rate exceeds the requirements of ISO 9170 – 1.
- Totally leak proof, safe & easy to operate.
- Configurations possible: surface, flush & Bead-head.

Oxygen Flow meter with Tubing Nipple/Humidifier Bottle –

Back Pressure Compensated flow meter for accurate gas flow measurement with following features:

- Control within a range of 0-15 LPM.
- It should meet strict precision and durability standard.
- The flow meter body should be made of brass or nickel chrome plated materials.

- The flow tube and shroud components should be made of clear, impact resistant polycarbonate.
- Flow tube should have large and expanded 0-15 LPM range for improved readability at low flows.
- Inlet filter of stainless-steel wire mesh to prevent entry of foreign particles
- The humidifier bottle should be made of unbreakable & reusable polycarbonate/ polysulfide material disinfect able as per infection control guidelines

NITROUS OXIDE SUPPLY SYSTEM

NITROUS OXIDE Manifold – 5 + 5 (Primary + Secondary)

Manifold shall consist of two high pressure header bar assemblies to facilitate connection of 5 nos of primary which will be the primary (main) supply source and 5 nos of secondary cylinder supplies which will be the Emergency supply source. Each header bar shall be provided with 5 numbers of cylinder pigtail connections to suit cylinder valves as per incorporating a check valve at the header connection. The high-pressure header bar shall be designed in such a manner that it can be extended to facilitate additional cylinder connections. Each header bar assembly shall be provided with a high pressure shut off valve.

Emergency NITROUS OXIDE Manifold – 3+ 3 Without Class-D type bulk cylinders-

Nitrous Oxide Manifold should consist of 2 rows of 3 no of class D-type bulk oxygen cylinders the manifold should be so designed that it shall suit easy cylinder changing and positioning. The system should have non – return valves for easy changing of cylinders without closing the bank along with individual cylinder valve and pressure relief valve. The cylinder should be placed with the help of cylinder brackets and fixing chains which should be galvanized.

Fully Automatic Nitrous Oxide Control Panel:

Automatic control panel should be constructed in accordance with the requirement of standards.

The fully automatic Nitrous Oxide control panel should comply with HTM 02-01/DIN/EN/ISO. It should be European CE Certified body with 500 LPM and should meet with the provisions of Council Directive 93/42/EEC concerning Medical Devices Directive.

The manifold assembly should provide two stages of pressure regulation. A single stage primary regulator, one for each cylinder bank should be used to initially reduce cylinder pressure and two single stage pressure regulators should be provided in the control cabinet for final delivery pressure regulation. One delivery pressure regulator in service and one should be ready for service in a standby mode. The Manifold control panel should be digital, fully automatic type and switches from "Bank in Use" to "Reserve bank "without fluctuation in delivery supply line pressure. Changeover should be performed by electrically/pneumatically operated valves contained in the control cabinet. In the event of an electrical power failure the valves should automatically open to provide an uninterrupted gas flow. It should be 100% automatic and should not require manual adjustment.

The automatic gas manifold control should include:

- Supply pressure gauges x 2nos
- Delivery pressure gauge x 1no
- Line pressure regulators with bypass valve x 2nos
- Line pressure relief valve x 1no
- Green in service led indicators, one for each supply bank x 2nos
- Amber / yellow ready for service led indicators, one for each supply valve x 2nos

- Red LEDs to indicate depleted cylinders, one for each supply bank x 2nos
- Instruction for changing the cylinders should be clearly identified on the front of the control panel.

All functional components should be enclosed in corrosion resistant robust material.

All components inside the Control Panel like Pressure Regulators, piping and control switching equipment should be cleaned for Nitrous Oxide Service and installed inside the cabinet to minimize tampering with the regulators or switch settings.

The Control Panel shall include two pressure relief valves, one high pressure approx. 200psi and one low pressure approx. 75 psi.

The heavy-duty control panel should be provided with a flow capacity of 500 LPM at 50 to 60 psi with electrical Heater

MEDICAL COMPRESSED AIR SYSTEM

QUADERPLEX MEDICAL DRY COMPRESSED AIR SUPPLY SYSTEM -as per NFPA-99 std / HTM - 2022/02-01/ IS/ISO 7396

- a) The system should be designed to deliver total plant capacity 8000 LPM to the hospital with additional standby system of the full capacity as per relevant standard and associated equipment, two vertical ASME or as per relevant standard Tank and control panel. The field connections required would be system intake, exhaust and power connection at the control panel. All components should be completely pre-piped and pre-wired to single-point service connections. All interconnecting piping and wiring should be completed and operationally tested at the site of manufacturer.
- b) The medical air compressors should be of oil-lubricated rotary screw air-cooled design.
- c) Each compressor should be belt driven by a suitable 3 phase, 50 cycle, 415 volt, ODP NEMA or as per relevant standard construction motor. Slide bases for convenient belt tension adjustment and totally enclosed OSHA approved belt guards should be provided.
- d) Each air compressor should have a requisite capacity at 100 PSIG to formulate the total plant capacity of 10000 LPM as primary and 10000 LPM of secondary.
- e) The system should include individual compressor inline intake filters, discharge check valves of bronze construction, safety relief valves, bronze intake and discharge flexible connectors, solenoid unloaders, isolation valves, air cooled after coolers for each compressor, high discharge temperature shut down switches on each cylinder, pressure control switches, as well as copper tubing with shut-off cock for gauge and switches. Pressure storage tank of ASME/ IS construction rated for 200PSI MWP service. The tank should be equipped with a pressure gauge, safety relief valve, 3-way by-pass; gauge glass and automatic electronic tank drain with manual override. The inside of the tank should be coated for rust protection with a two-component coating which provides a hard, durable lining. Provide spring vibration isolators for each compressor.
- f) The system should include a control panel as per relevant standard enclosure with the following accessories for each pump:
 - Externally operable fusible disconnect with door interlock, control circuit transformer with fused primary and secondary coils, H-O-A switch, magnetic starter with 3 leg overload protection, hour meter, motor running light. Provide the panel with a multiple position selector switch for

selection of normal operation (automatic alternation) or manual selection of lead and lag pumps if one of the pumps is taken out of service due to scheduled maintenance. Provide audible and visual local alarm (complete with indicating lights and individual sets of auxiliary contacts wired to the terminal strip for remote alarm indication) for the following: compressor temperature malfunction and reserve compressor in use.

- Provide manual reset for thermal malfunction shutdown. All control and alarm functions should remain energized while any compressor in the system remains electrically on-line. The lag compressor should be able to start automatically if the lead compressor fails to operate.

STANDARD BILL OF MATERIAL FOR QUADERPLEX

- **DESCRIPTION**
- **Quadraplex**
- Oil-free rotary screw Compressor
- Belt Guard
- Electric Motor
- High Air Temperature Switch
- Air Receiver (ASME Rated) or as per relevant standard
- Control Pressure Switch
- Three-Valve By pass
- Sight-Gauge Glass
- Pressure Gauge
- Pressure Relief Valve
- Automatic Tank Drain
- Electrical Control Panel
- NEMA 12 Enclosure or as per relevant standard
- Power Distribution Block
- Combination Motor Starters with Circuit Breaker Disconnects
- Automatic Alternation
- Running Lights
- Hour Meters
- Control Transformer
- Hand-Off Automatic switch
- High-Air Temperature Light with contacts
- Lag On Alarm with Horn, Light & contacts
- Interconnecting piping
- Compressors Isolating Valve
- Check Valve
- Compressor Inlet flex connectors
- Compressor Discharge Flex Connectors
- System Flex Connector
- Vibration Dampeners

MEDICAL VACCUM CENTRAL SYSTEM

QUADERPLEX VACUUM (SUCTION) SUPPLY SYSTEM – as per NFPA-99 std / HTM - 2022/02-01, IS/ISO 7396

The system should be designed to deliver total plant capacity 6500 LPM to the hospital with additional full capacity standby system as per relevant standard.

The Oil Lubricated Rotary Vane Medical Vacuum System should provide superior performance with minimal maintenance. The system should contain all necessary controls and components to meet or exceed above recommended Guidelines or as per relevant standard. Systems should be available in simplex and all multiplex arrangements. The vacuum system should consist of rotary vane vacuum pumps, pre-wired control panel, receiver (two), and interconnecting wiring and piping, requiring only two plumbing connections. The vacuum pumps should be continuous duty, rotary vane, oil-sealed, air

cooled, direct driven units capable of continuous operation over a wide working range. Each pump should have single shaft seals and should be equipped with an automatic gas ballast valve to prevent condensation of water vapor, extending the life of the oil and the system.

Lubrication should provide by the integral, fully re-circulating oil supply. The pump inlet should be protected by means of a wire mesh screen. An internal anti suck back valve should be included to prevent oil from entering the vacuum piping network. Pump vanes, because of their construction, should provide superior heat transfer and long life. The pumps should be dynamically balanced and virtually vibration free.

Each pump should be driven by a direct flanged three-phase, standard motor via a pin and bush coupling. Pumps require standard automotive grade SAE-30 non-detergent oil for lubrication.

The electrical control panel should be mounted in a control cabinet. The standard control panel includes the following components:

- Integral circuit breaker disconnected with door interlock, across-the-line motor starters with three-phase overload protection
- A programmable logic controller to cycle lead pump with each use
- Hand off Automatic selector switch for each pump
- Lag pump in use indicator light with horn and connection for remote annunciation Hour meters to monitor factory recommended service intervals. Pump running lights to indicate pump in operation.

Each system should include two ASME/ IS coded receiver rated for full vacuum service. The system receiver should include a 4-1/2" vacuum gauge, manual drain, and three- valve by pass. Additionally, each system should include properly sized inlet and exhaust flex connectors and vibration isolation pads for field installation. The pump has the facility that in case one pump stops the standby pump should automatically start. If any pump fails the system should automatically revert to the stand by pump. All the status monitoring of the pump can be connected to the Master Alarm. The system should also include factory installed 5-micron pump inlet filters to promote longer life.

Standard Bill of Material Oil-Lubricated Rotary Vane Vacuum System

- **Description Quadraplex**
- Rotary Vane Pump
- TEFC Motors
- Back Pressure Indicator Gauge
- Oil Reservoir
- Oil Sight-Gauge Glass
- Air Receiver (ASME Rated) or as per relevant standard
- Three Valve Bypass
- Control Vacuum Switch
- Vacuum Gauge
- Manual Drain
- Electrical Control Panel
- NEMA 12 Enclosure or as per relevant standard
- Integral Motor Starter with Circuit Breaker Disconnect
- Automatic Alternation
- Running Light
- Hour Meter
- Minimum Run Timer (7.5 hp and larger)
- Control Transformer
- Hand-Off-Automatic Switch
- Lag On Alarm with Horn, Light & contacts
- Interconnecting piping

- Pump Isolation Valve
- Check Valve
- 5 Micron Pump Inlet Filter
- Pump Inlet Flex Connector
- Pump Discharge Flex Connector
- Receiver Flex Connector
- Vibration Dampeners

Ward Vacuum Units-

It must consist of the following: -

- 1no of Suction Regulator and 1no of 600 ml polysulfone /polycarbonate collection jar.
- Suction Regulator: Suction regulator should be supplied with a safety jar, including and antibacterial filter and an anti-overflow safety device. Should have wide membrane continuous suction controller
- Should have vacuum levels: 0-760 mm of Hg
- Should have vacuum gauge fitted with a protective bumper device.
- Should have on/off knob allowing for the quick restoration of a readjusted vacuum level.
- Must have central adjustment knob with a colour coded for 0 to 760 mm of Hg.

THEATRE VACCUM UNIT

It should be capable to mount 2 canisters, each canister of 2000 ml capacity. The stand should be durable; chrome plated steel construction with five no. snag, free spinning, and rotating casters. It should have two shut off valves for controlling suction to the canisters and should have the features to selects the canister.

The Regulator should have soft touch knob for easy access to (a) On/off mode (b) Regulation mode (c) full flow of vacuum pressure directly from vacuum line Mode.

The analogy gauge should have 2" Dia color coded; glow - in - the - dark face for easy readability under any condition.

Suction jar should be made of polycarbonate and disinfect able as per infection control guidelines. The jar capacity should be 2000 ml. It should have a positive shut off Metal cap & float assembly that interrupts suction to help prevent fluid carryover into the regulator. The float & cap assembly should include a patient port inlet that is horizontal to help prevent kinking of suction tubing, a vacuum port that is filled with vacuum DISS swivel nut fitting & an adjustment to allow suspension from the wall using proper accessories.

All collection bottle assemblies allow visual inspection of fluid level, color & consistency & can be steam autoclaved or gas sterilized. Polycarbonate bottles offer the additional advantage of eliminating breakage.

AGSS SYSTEM (1200 LPM)

Anesthesia Gas Scavenging System shall confirm to NFPA 99/ HTM 02-01/EN/ISO/DIN.

Duplex Rotary Vane or Blower medical vacuum system tank mounted suitable for 16 nos operation theatre on horizontal reservoir provides superior performance with minimal maintenance. The packaged system contains all necessary controls and components to exceed recommended guidelines or HTM/EN/ISO/DIN.

The WAGD or AGSS pumps are continuous duty dry-running units with carbon graphite self- lubricating rotary vanes. The pumps are air cooled and direct driven, capable of continuous operating over a working range of 0" to 15 Hg. The pumps are completely self- contained units, requiring no external coolers, pumps, separators or reservoirs. Lubrication is provided by the self-lubricating self-adjusting carbon graphite vanes. The carbon graphite vanes have a life of 8,000 to 15,000 hours, depending on the size of the pump. The pump inlet is protected by means of an integral, 5-micron inlet filter. The rotary design is dynamically balanced and virtually vibration free. The pumps are constructed of

heavy-duty aluminium alloy, providing superior heat transfer and long life. The pumps are equipped with large cooling fins and a sound-attenuating enclosure to assure cool, quiet operation.

Each pump should be driven by a direct-flanged three-phase standard TEFC motor via a pin and bush coupling.

The electrical controls are mounted as per relevant standard control cabinet. The standard controls include:

- Combination circuit breaker disconnects, non-reversing, across-the line motor starter with three-phase overload protection
- A programmable controller to cycle lead pump with each use.
- Hand-Off Automatic selector switches
- Lag pump in use indicator light with horn and connection for remote annunciation
- Hour meters to monitor factory recommended service intervals
- Running lights indicating pump in operation

The system is supplied with properly sized inlet, discharge flex connectors and vibration isolation pads for field installation. As options, the system can be supplied with a discharge silencer and / or bacterial filters for field installation.

The system includes a coded receiver rated for full vacuum service. The receiver includes a 4-1/2" vacuum gauge, manual drain, and three-valve by pass.

CARBON DIOXIDE SUPPLY SYSTEM

CARBON DI OXIDE Manifold – 5 + 5

Manifold shall consist of two high pressure header bar assemblies to facilitate connection of 5 nos of primary which will be the primary (main) supply source and 5 nos of secondary cylinder supplies. Each header bar shall be provided with 5 numbers of cylinder pigtail connections to suit cylinder valves as per incorporating a check valve at the header connection. The high-pressure header bar shall be designed in such a manner that it can be extended to facilitate additional cylinder connections. Each header bar assembly shall be provided with a high pressure shut off valve.

The manifold should be so designed that it shall suit easy cylinder changing and positioning. The system should have non – return valves for easy changing of cylinders without closing the bank along with individual cylinder valve and pressure relief valve. The cylinder should be placed with the help of cylinder brackets and fixing chains which should be galvanized.

Fully Automatic Carbon Dioxide Control Panel:

Automatic control panel should be constructed in accordance with the requirement of standards.

The fully automatic Carbon Di Oxide control panel should comply with HTM 02-01/DIN/EN/ISO. It should be European CE Certified with notified body with 500 LPM.

The manifold assembly should provide two stages of pressure regulation. A single stage primary regulator, one for each cylinder bank should be used to initially reduce cylinder pressure and two single stage pressure regulators should be provided in the control cabinet for final delivery pressure regulation. One delivery pressure regulator in service and one should be ready for service in a standby mode. The Manifold control panel should be digital, fully automatic type and switches from "Bank in Use" to "Reserve bank "without fluctuation in delivery supply line pressure. Changeover should be performed by electrically/pneumatically operated valves contained in the control cabinet. In the event

of an electrical power failure the valves should automatically open to provide an uninterrupted gas flow. It should be 100% automatic and should not require manual adjustment.

The automatic gas manifold control should include:

- Supply pressure gauges x 2nos
- Delivery pressure gauge x 1no
- Line pressure regulators with bypass valve x 2nos
- Line pressure relief valve x 1no
- Green in service led indicators, one for each supply bank x 2nos
- Amber / yellow ready for service led indicators, one for each supply valve x 2nos
- Red LEDs to indicate depleted cylinders, one for each supply bank x 2nos
- Instruction for changing the cylinders should be clearly identified on the front of the control panel.

All components inside the Control Panel like Pressure Regulators, piping and control switching equipment should be cleaned and installed inside the cabinet to minimize tampering with the regulators or switch settings.

The Control Panel shall include two pressure relief valves, one high pressure approx.200psi and one low pressure approx.75 psi.

The heavy-duty control panel should be provided with a flow capacity of 500 LPM at 50 to 60 psi. with electrical heater

COPPER PIPE DISTRIBUTION

Piping specifications

Copper pipe should be as per standard BS: EN 13348 :2008 standards; Solid drawn, seamless, deoxidized, non-arsenical, half hard conditioned (R 250), tempered and degreased copper pipe conforming to the standard and carbon content test shall have to carried out using reference method described in EN 723. All copper pipes should be degreased & delivered capped at both ends. The pipes should be accompanied with manufacturers test certificate for the physical properties & chemical composition. All Pipes shall have manufacturer's name, number of this standard, nominal cross-sectional dimensions of pipe: outside diameter x wall thickness, temper (half hard) date of manufacture & Lot/Batch No and end capped.

Copper pipe must have reputed third party inspection certificate (E.g. Lloyd's or Kite marked or TUV or SGS). Fittings should be made of copper and suitable for a working Pressure of up to 17bar and especially made for brazed socket type connections.

The isolation valve body shall be made of chromium plated brass with non-lubricated ball-type. All valves shall be pneumatically tested for twice the working pressure and factory degreased for medical gas service.

Copper fittings should comply with EN 1254:1 factory degreased and brazing filler metals should comply with EN 1044. Fitting should be degreased, individually packed for medical use.

Installation & Testing The manufacturer of Copper Pipe must be equipped with major manufacturing equipment's namely Induction Melting Furnace, Extrusion Press, Pilger Mill, Draw Bench, Roller Hearth Bright annealing furnace with Temperature controller, Degreasing Station etc. & in.house test equipment's like Direct emission Spectrometer, Eddy current, Carbon Determinator, UTM, De-greasing station etc.

All Copper Pipes shall have been Inspected & Certified by Lloyd's Register Asia and manufacturer shall comply with BS: EN 9001:2000.

Pipes shall be delivered in bundles in protective bags, which are secured and clearly levelled and identified as 'Degreased for Medical Gas Lines.

Copper Pipe Fittings:

All copper fittings should be of Delcop end feed type (elbow, tee, coupler) manufactured to BS: EN 1254.1:1998 and should be degreased in the factory and individually packed for use in medical gas piping system. Copper fittings should be to EN 1254.1 (up to 54mm). The manufacturer of Copper Fittings should comply with BS: EN ISO 9001:2000 Manufacturer of Copper pipe fittings should provide following supporting documents/certificates indicating that degreasing has been carried out, that any hydrocarbon in the bore area is less than 100mg/m².

Certificate of conformity Oil analysis certificate

Brazing Rods:

Copper to copper joints shall be brazed using a brazing rod CP104 (5% silver_copper phosphorous brazing alloy) and Copper_to_brass or_gunmetal joints shall only be joined using brazing rod AG 203 (43% silver_copper_zinc_brazing alloy) manufactured to BS: EN 1044:1999 Valves and Terminal units: Ball valve with male screw threads and flat tightened solder unions, front ends with slots to incorporate o_ring, oil.free and degreased, for medical gases and vacuum, handle with safety device securing handle in operating position, marked according to DIN/ EN 19.

Valves & Gas Outlets:

Valves and Gas Outlets shall be individually sealed in polythene bags without capping. A certificate from the manufacturer shall be supplied for each valve and fittings (or each batch) stating that pressure tests and degreasing have been carried out, that any solvents have been completely removed to medical gas standards, and the valves tested to the specific pressure.

Installation: Inert gas welding technique should be used by passing oxygen Free Nitrogen Gas inside the copper pipes during silver brazing, in order to avoid carbon deposition inside the copper pipes. Copper pipes of the diameter up to 42mm OD should be installed on the wall with the help of plastic saddles/Brass Ring at the required span, as per HTM.02.01 of U.K. and metallic white powder coated clamps should be used for pipe sizes above 54mm OD. Wherever the pipes cross brick walls, it should be covered with plastic pipes. All pipes should be protected against mechanical injury in a manner satisfactory to authorities having, jurisdiction.

Only copper. _ to copper joints are permitted on site except threaded or flanged joints may be made where pipelines are connected to items such as valves and control equipment. No flux shall be used for joining Copper to Copper joints and on for joints made on site. Copper to copper joints shall be brazed using a 5% silver_copper phosphorous brazing alloy CP104. A total of 5 joints shall be cut out for examination to establish the quality of the joints being made on site. The insides shall be clean and free from oxides and particulate matter and the minimum penetration of the brazing alloy at any point shall be three times the wall thickness of the tube

. If the joints examined do not conform to these requirements, then adjacent joints shall be cut out and examined until the extent of faulty workmanship has been made good.

Copper. . to brass or gunmetal joints shall only be made under controlled conditions off site. The joints are ordinarily used to join short copper pipe tails to brass, gunmetal or bronze fittings to permit their connection into the pipeline. The sub-assemblies shall be degreased and individually sealed in bags or boxes before delivery to site. The brazing shall be carried out using a copper-silver-zinc-brazing alloy AG 203 and an appropriate flux.

The pipeline shall be adequately supported at sufficient intervals as tabulated herein. The supports shall be of suitable material or suitably treated to minimize corrosion and prevent electrolytic action between the pipes and supports.

Outside Diameter (mm)

12 X0.7mmX6000mm
15 X0.9mmX6000mm
22 X0.9mmX6000mm
28 X0.9mmX6000mm
35 X1.2mmX6000mm
42 X1.2mmX6000mm
54 X1.2mmX6000mm
76 X1.5mmX6000 mm
108 X1.5mmx6000mm

Where pipes pass through walls, partitions or floors they shall be fitted with sleeves of Copper Pipes and provided with appropriate escutcheon plates where exposed to view. The sleeves shall project a distance of 25 mm beyond the surface of penetration. The annular space between the sleeve and pipe shall be tightly caulked with a suitable material.

Concealed pipe work shall not be sealed in until it has satisfactorily passed all visual inspections and pressure tests. Once covered, the route of the buried pipe work shall be clearly and continuously marked by chalk, colored adhesive tape or otherwise during construction, to discourage the insertion of fixings into or near the pipe by other trades.

Due allowance shall be made in the installation for building movement at all constructional expansion joints.

The contractor shall design and provide supports, brackets and hangers for all pipe work in accordance to BS 3974. The contractors shall coordinate the tie-in of pipe supports with Structural and Architectural Works and provide additional support structures where necessary.

Before starting of any Installation/ Testing/ Commissioning works contractor has to submit detailed method statement for approval.

Painting

All exposed pipes should be painted with two coats of synthetic enamel paint and color codification should be as per standards.

MEDICAL AREA VALVE SERVICE UNIT

ZONE VALVE BOX As per NFPA -99 std, HTM -2022/02-01, IS/ISO

7396.

(2 Gas)
(3 Gas)
(4 Gas)
(5 Gas)
(6 Gas)

Medical Gas Area Alarm

Area valve service units should fully comply and meet with HTM 02-01/EN/ISO/DIN.

The unit should be pre-piped, wired and tested ready for installation into a finished building. Medical gas/vacuum services should be fixed copper, piped to and from their respective area valve service units. A color-coded service identity label should be fitted behind the valve handle. The unit should provide a zone isolation facility, for use either in an emergency or for maintenance purposes. The box shall be made from extruded aluminum to prevent corrosion. All wetted parts (except seals and gaskets) should be brass or copper. Each unit assembly should be factory tested for gas tightness. Rubber pipe grommets should be provided to ensure any leaking gas does not escape from the unit into a wall cavity. All visible aluminum surfaces should be powder coated.

Medical Gas Area Alarm -

The medical gas central alarms should be capable of monitoring 6 medical gas services by means of pressure sensors which detect deviations from the normal operating limits of either pressure or medical vacuum. The area alarm should have a digital display of pressures. The medical gas area alarm should fully satisfy the HTM 02-01/EN (ISO-7396-1)/DIN requirements.

Each gas service should be displayed by colored LED's to show 'Normal' (green), 'Low' and 'High Pressure' (red) conditions. Medical vacuum systems should be displayed in the 'Normal' (green) and 'Low Vacuum' (red) conditions only.

Failure indications should be displayed by flashing lights and normal indications should be steady light. An audible warning should sound simultaneously with any failure indication and a mute facility should be provided. Following a mute selection the audible should resound after approximately 15 minutes, or should operate simultaneously should a further alarm condition occur. A maintenance "Mute" switch should be provided internally to the panel for use during maintenance which results in prolonged pipeline or plant shutdown. This facility should automatically reset when the gas service returns to normal.

The alarm panel should have a 'test' facility to prove the integrity of the internal circuits, LED's and audible warning. The alarm panel should incorporate a volt free normally closed relay to allow for interconnection to either a medical gas central alarm system or an event recording circuit of a building management system.

The alarm should be microprocessor based with individual microprocessor on each module and should provide interface to Gas Delivery Management System. A centralized alarm in the manifold room is also essential.

(2 Gas)

(3 Gas)

(4 Gas)

(5 Gas)

(6 Gas)

ALARM SYSTEM

Master Alarm

Each Master Alarm should be modular in design and be fitted with required number of master alarm modules. The master alarms should be capable to monitor from 10 to 30 points in a standard box or 10 to 50 points in a large box.

Each point represents an alarm condition that the source equipment might have. When an alarm condition exists, a red light flashes and the audible alarm sounds. If several alarm conditions occur

simultaneously, the most recent alarm light should flash, while the other alarm lights should remain lit. When an alarm condition is created, an audible alarm should be actuated. A dry contact module should be available to interface with a building management system.

The box material should be of gauge steel of requisite thickness and equipped with mounting brackets that are adjustable up to a drywall thickness of 1-1/4" (32 mm).

Bidder shall be responsible for all cabling from local alarm panels to master alarm panel.

Features

- Complies with HTM 02-01 /EN (ISO-7396-1)/DIN.
- High visibility LED/LCD readouts
- Circuitry allows for Normally Open or Normally Closed.
- Adjustable audible alarm repeat (from 1 to 99 minutes)
- Can be interfaced with BMS

Medical Line Isolation Valve

SPECIFICATIONS As per NFPA -99 std / HTM -2022/02-01/DIN/ISO

ISOLATING VALVE

- 15mm OD
- 22mm OD
- 28mm OD
- 42mm OD
- 54mm OD
- 76mm OD
- 108 mm OD

All ball valves as per BS 1057 are rated at 400 psig, as well as full vacuum (29.9" Hg). Valves go from full ON to full OFF by turning the vinyl-gripped valve handle 90 0 Locking- type handles may be ordered separately when required. Copper tubing is factory installed to help prevent valve seat damage during brazing. Main and riser valves are not required to be installed in a box unless specially noted or required.

BED HEAD PANELS

Horizontal Bed Head Panel.

It shall conform to ISO Standards. It should have following features ·

- Efficient, Safe & Robust design in extruded aluminium section.
- Smooth curved surfaces, and choice of base colour and fascia plates.
- Unit should have integrated rail system to mount accessories
- The headwall system should be constructed of aluminium extrusions joined together to form a carcass to suit the particular application. Unit should be factory assembled for electrical and mechanical components.
- Segregation of services i.e. Low voltage supplies, High Voltage supply and medical gases should be maintained throughout.
- Front fascia plate should be removable individually to access for respective service.
- Bed space management system with optional equipment rail. With all Equipment Rail mount Accessories.
- All down drops should be installed at one end preferably & Vertical drop installed at one end should be covered with Aluminium boxing with matching colour.
- Entire pipe line should run in continuous horizontal panels with no break for each unit & length as per area where it has to be installed.
- Each bedhead unit shall be supplied with electrical and electrical outlets pre-fitted, wired and certified. (wired up to the distribution box provided with leakage protection)

Facility per unit as under:

Critical Areas	General Ward Beds
Oxygen – 2	Oxygen – 1
Vacuum – 2	Vacuum – 1
Medical Air-2	Medical Air-0
Holder for vacuum collection jar –1	Holder for vacuum collection jar –1
Nurse call switch – 1	Nurse call switch – 1

Infusion pump mount pole with adapter for mounting at least two infusion pumps
5 /15 A combined Electrical outlets – 10
RJ-45 socket -02
Two spare spaces
Outlets and nurse switch cut out only
Monitor Bracket

Infusion pump mount pole with adapter for mounting at least two infusion pumps
5 /15 A combined Electrical outlets – 4
RJ-45 socket -01
Two spare spaces
Outlets and nurse switch cut out only
Monitor Bracket

Electrical Control Panel

The electrical control should comply with ISO Standards. The "Continuous on Demand" feature will stop the operation of the motors during periods of low or no demand. The control includes individual self-protected combination motor controls with short circuit protection, single phase and thermal overload protection, individual control circuit transformers with fuse-less primary and secondary protection, pressure sensors, temperature switches with reset buttons, and an electronic controller to automatically change the operating sequence of the compressors. The cabinet shall have status display to include system pressure, dew point pump operation, accumulated time, maintenance interval, fault conditions, and silence button, lighted Hand Off-Automatic selector switches and safety disconnect operating handles. All required local alarm functions shall be integrated in to the packaged system.

Electrical Wiring inside gas Manifold and Plant Room

Its should be as per standard and best quality as per the makes and specifications provided in the electrical section of the tender

Supply installation testing and commissioning of HP Antistatic Tube as per standards

TESTING AND COMMISSIONING

During the Contract Period Pressure_test, for leakage in pipelines only

Check valve tightness and correct valve zoning

Test relief valve operation

Pressure_test, for leakage in complete installation

Check for satisfactory mechanical operation and non-interchangeability of each terminal unit by means of test probes.

Check for cross connections (sometimes referred to as 'anti.confusion test' or 'continuity test')

Check flow rate and pressure at each terminal unit

Check total flow rate and delivery pressure

Check satisfactory operation of manifold changeover valves

Check satisfactory operation of medical gases and vacuum pumps and all manifolds (including emergency supply panels).

Check performance of alarm signaling system

Purge the completed installation with medical air and check the internal cleanliness of the system.

Purge the completed installation with the working gas.

All tests and checks during the contract period shall be witnessed by the Representative and proper test reports to be submitted for approval

Procedures a, b and c will normally be completed in sequence for one gas at a time. After completion of procedure (d) (separately for each gas) and (e), arrangements shall be made for tests of (f) and (g) to be completed for the whole installation at one session. The remainder of the procedures shall then be completed, in the order given, for each gas. After completion of Contractor's works

Check the identity of the gas supplied at each terminal unit

Check the quality and purity of gas at each terminal unit

All tests after completion of the installation will be carried out by the Contractor in the presence of the representative. In addition to any certificates required from the Contractor, a certificate in the prescribed form (attached) should be completed before the system is taken into use.

Pressure testing for leakage is carried out in two stages for the medical gas system and in three stages for the vacuum system. The first pressure tests cover the complete pipe lines and isolating valves only. The other pressure tests cover the whole installation, including terminal and theatre fittings.

Vacuum installations should be thoroughly dried out, usually by the operation of the vacuum pumps, before final vacuum testing is undertaken.

Each valve tightness test shall be held for not less than 15 minutes.

During pressure tests the pressure in the systems will vary with the temperature according to the gas law. It should be noted that assessment temperatures are to be based on the mean temperature of the gas at the time observations are made. The pressure will rise or fall by $1/273$ bar for each °C change in temperature.

If the relief valves cannot be set to protect the installation during the pressure test, they shall either be temporarily replaced by others which can withstand the test pressure or be blanked off.

Pressure test for leakage in pipe lines.

The completed pipe lines with all ends sealed (but Gas Outlets not fitted), all valves on the distribution system open, and with control panel and fittings disconnected, shall be tested to twice the working pressure or a gauge pressure of 10.5 bar whichever is the greater. This pressure shall be held for 24 hours and no leak shall occur during this period.

Test for leakage on vacuum system.

The completed pipe lines with all ends sealed (but Gas Outlets not fitted), all valves on the distribution system open, and control panels and theatre fittings disconnected shall be tested at a gauge pressure of 6.9 bar. This pressure should be held for 24 hours and no leak shall occur during this period.

Valve Tightness Tests

On completion of the pressure test on the pipe line all isolating valve shall be tested for 15 minutes at a gauge pressure of 6.9 bar for tightness by closing them in sequence and releasing the pressure on the downstream side. No leak shall occur during these valve tests.

Relief Valve Test

On completion of the isolating valve tightness tests the pressure on the medical gas and vacuum systems shall be reduced for the purpose of testing the safety valves. The service safety valve shall be fitted and this shall be tested to ensure that it discharges safely at 125% of the working pressure.

Test for leakage on Completed Installation -Medical Gases

With all Gas Outlets and theatre fittings connected the completed installations shall be tested at the working pressure which shall be held for 24 hours. No leak shall occur during this period but a loss of up to 0.15 bar could be accepted on a pipeline having more than 50 terminal units.

Test for leakage on Completed Installation -Vacuum System

Test for Leakage on Completed Installation

The complete pipe lines with all ends sealed (but outlets not fitted), all valve on the distribution system open and control panels disconnected should be tested at a gauge pressure of 6.9 bar. This pressure should be held for 24 hours and no leak should occur during this period.

Tests for proving correct connections to all the systems

Each system (oxygen and vacuum) shall be tested in turn, preferably at the same session. The tests shall not ordinarily be embarked upon until all works on all the installations are completed.

Medical gases shall not normally be used for these tests because of the risks arising from their discharge. A medical compressed air plant may be used to supply the test gas but air from ordinary industrial lubricated compressors should not be used. If no medical compressed air plant is available the air supply shall be obtained from test cylinders of medical quality provided by the Contractor at his own cost.

The system under test shall be connected at the normal working pressure. The other systems shall be isolated at their sources of supply but all other isolating valves on all systems shall be OPEN.

The contractor engineer shall check in every room to ensure that the test gas is delivered from every terminal unit bearing the name of the 'gas' and is not delivered from any other terminal unit.

The tests can be made with bobbin type flow_meters or plug_in type flow metering equipment designed to pass the quantities specified in paragraph 34 to 48 of HTM22or approved equivalent standard with diversity as indicated therein. Calibrated jets conforming to BS720 or approved equivalent standard shall form the basis of the test equipment for medical gas installations. The jet metering devices shall best amped to show:

Jet size.

Air equivalent of 'medical gas' for which it is calibrated.

Rate of flow and pressure for which it is calibrated.

The total flow tests on oxygen and medical vacuum mixture installations shall not be conducted with these gases but with medical quality compressed air at a gauge pressure of 4.1bar. The metering devices for these tests shall be marked 'air equivalent of medical gases'. Test jet units for general medical gases, shall be calibrated to pass 40 litters, 20 litters and 15 litters per minute at a supply gauge pressure of 6.9bar. Units for compressed air shall be calibrated to pass 250bar, 50litters/ minute for general Gas Outlets and 65 litters/minute for dental department terminal units, the last two at gauge pressure of 3.9bar. Units for vacuum shall have flow meters suitable for passing up to 40 litters/minute of free air. The minimum acceptable pressure on the test instrument gauge during these tests is given in Clause 14.10.

Acceptable pressure on flow rate/delivery pressure tests for medical gases and medical vacuum the minimum acceptable pressure on the test instrument gauge during these tests is as follows:

The action of the manifold change_over valve can be tested by connecting a smaller cylinder of the work gas or of medical quality compressed air on each side of the manifold and discharging it to a carefully sited leak whilst the operation of the pressure gauges and change_over valve is checked. Each

half of the manifold shall be tested in this manner. This test could be carried out on every automatic manifold during the period when the flow rate tests are in progress. Pressure regulating valves affect the changeover of the manifold supply in these cases and will be checked as below.

Plant Operation Tests

The following checks shall be carried out before the alarm system is tested.

For manifold installations check operation of all magnetic valves.

Check operation of heater where fitted. Check effectiveness of change-over to reserve manifold.

Check that each item of plant is capable of operating continuously at its maximum continuous rating.

Check accuracy of all pressure gauges and thermometers.

Check insulation resistance and effectiveness of earthing of all electrical items.

Signaling System Test

This test shall be carried out simultaneously with the test of the manifold changeover valve.

Purging Medical Gas Installations

Each system shall be purged with the working gas on completion of other tests on the installations.

Gas Identification, Quality and Purity Check

A rough indication of gas identity can be obtained by the use of an oxygen analyser. Thus, readings of about 0%- 100% imply respectively nitrous oxide and medical oxygen. It must be realized however that these are not absolute identifications, as other gases involved are not identified nor are contaminants. Such instruments shall be kept in good working condition and be regularly checked by the makers or by a reputable laboratory.

SCHEDULE OF ITEMS	
S.No	Description of Items
A OXYGEN SYSTEM	
1	Liquid Oxygen Tank of 8K Ltr. with all required accessories
2	10+10 size Primary Main Oxygen Manifold complete with NRvs and pig tail pipes. (Cylinder will be provided by the Hospital)
3	Fully Automatic control panel for Oxygen Having a constant flow out put of over 2000 LPM at 4.2 bar pressure.
4	10+10 cylinder Oxygen emergency manifold complete with NRVs and pig tail pipes. (Cylinder will be provided by the Hospital)
5	Fully Automatic control panel for Oxygen Having a constant flow out put of over 2000 LPM at 4.2 bar pressure.
6	Oxygen Gas Outlets complete with probe
7	BPC Oxygen flow meter with Humidifier Bottle. 0-15 L/min standard flow rate.
8	Oxygen High Pressure Rubber tube white color.
B NITROUS OXIDE SYSTEM	
1	(5+5) Cylinder size of Primary Main Nitrous Oxide Manifold complete with NRvs and pig tail pipes. (Cylinder will be provided by the Hospital)
2	Fully Automatic control panel for Nitrous Oxide Having a min. flow out put of 500 LPM at 4.2 bar pressure.
3	(3+3). of Cylinder size of N2O Emergency cylinder manifold complete with Regulator, NRvs & Pig tail pipes. (Cylinder will be provided by the Hospital)
4	Nitrous Oxide Gas Outlets
5	Nitrous Oxide High Pressure Rubber tube Blue color.
C CARBON DIOXIDE SYSTEM	
1	(5+5). Cylinder size of Primary Main Carbon dioxide Manifold complete with NRvs and pig tail pipes. (Cylinder will be provided by the Hospital)
2	Fully Automatic control panel for Carbon dioxide Having a min. flow out put of 500 LPM at 4.2 bar pressure.
3	(3+3) Cylinder size of CO2 Emergency cylinder manifold complete with NRvs & Pig tail pipes. (Cylinder will be provided by the Hospital)
4	Carbon Dioxide Gas Outlets with probe
5	Carbon Dioxide Antistatic High Pressure Rubber tube
D VACUUM SYSTEM	
1	Quardplex Vacuum Central System Complete with 04 nos. The vacuum system should consist of Rotary vane vacuum pumps, Total plant capacity 6500 LPM as Primary with additional full capacity standby system as per relevant standard with Filter, interconnecting pipes, NRV, auto switch gear assy., exhaust silencer.
2	Vacuum Receiver of 3000 Ltrs Capacity.
3	Bacterial Filter
4	Vacuum Gas Outlets.
5	Ward Vacuum Unit with Regulator, Collection Jar of 600 ml with Bracket.
6	Theatre vacuum unit trolley mounted complete with 1no. of high suction regulator along with twin vacuum collection jar of Polysulphone of 2000ml with lid.
7	Vacuum Antistatic High Pressure Rubber tube Yellow color.
8	Vacuum Low Pressure Rubber tube
E COMPRESSED AIR SYSTEM	
1	Quardplex Compressed Air system complete with minimum capacity 04 nos. The medical air compressors should be of oil- lubricated rotary screw air-cooled design . Each air compressor should have a requisite capacity at 3000lpm to formulate the total plant capacity of 10000 LPM as primary and 10000 LPM of secondary.

2	MA4 Receiver of Capacity 2500 Ltrs
3	SA7 Receiver of Capacity 2500 Ltrs
	100cfm Heatless Air Dryer
4	4-stage Air Filtration System
5	Pressure Reducing System
6	Medical Air 4 Bar Gas Outlets
7	Medical Air 7 Bar Gas Outlets
8	Compressed Air Antistatic High Pressure Rubber tube Black color.
F	AGSS PLANT SYSTEM
1	Duplex each plant capacity of minimum 1200 LPM
2	AGSS Gas Outlets.
3	AGSS High Pressure Rubber tube
G	MISCELLANEOUS ITEMS
1	Combined Electrical Control Panel for Vacuum System, Compressed Air System(Cascading / seq.) and AGSS Plant complete with plant Room wiring.
H	Distribution Copper Pipe : Lloyd Company with Testing Certificate
1	108 mm OD x 1.2 mm thick
1	76 mm OD x 1.2 mm thick
2	54 mm OD x 1.2 mm thick
3	42 mm OD x 1.2 mm thick
4	28 mm OD x 0.9 mm thick
5	22 mm OD x 0.9 mm thick
6	15 mm OD x 0.9 mm thick
7	12 mm OD x 0.7 mm thick
I	Zonal Valve Box with Ball Valve & Pressure Gauge.
1	6 gases
2	3 gases
3	2 gases
J	Area Valve Box with Ball Valve & Pressure Gauge.
1	6 gases
2	3 gases
3	2 gases
K	Medical Gas Digital Alarm System
1	6 gases
2	3 gases
3	2 gases
L	Main Master Alarm
M	Isolation Valve
1	22 MM.
2	28 MM.
3	42 MM.
4	54 MM.

N	Bed Head Panel without Out - Let provision
1	2 Gas Out-Let BHP-1000mm
2	3 Gas Out-Let BHP-1200mm
3	6 Gas Out-Let BHP -1500mm

Note : The schedule of items mentioned above are indicative and not exhaustive, Any item not stated under this section but shown in the GFC drawings / Particular specifications shall deemed to be included under the scope of this item.

LIST OF APPROVED MAKE (MGPS)

List of Makes for MGPS		
S.No	Description of Items	Makes
A	Oxygen	
1	10 x 10 size Primary Main Oxygen Manifold complete with NRVs and pigtail pipes. (Cylinder will be provided by the Hospital)	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
2	Fully Automatic control panel for Oxygen Having a constant flow output of over 2500 LPM at 4.2 bar pressure.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
3	10 x 10 cylinder Oxygen emergency manifold complete with NRVs and pig tailpipes. (Cylinder will be provided by the Hospital) Make: SMM	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
4	Oxygen Gas Outlets complete with probe	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
5	BPC Oxygen flow meter with Humidifier Bottle. 0-15 L/min standard flow rate.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
6	Oxygen High-Pressure Rubber tube white colour.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
B	Nitrous Oxide	
1	(5+5) Cylinder size of Primary & Secondary Main Nitrous Oxide Manifold complete with NRVs and pig tailpipes. (Cylinder will be provided by the Hospital)	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
2	Fully Automatic control panel for Nitrous Oxide Having a min. flow output of 1000 LPM at 4.2 bar pressure.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv

List of Makes for MGPS

S.No	Description of Items	Makes
3	(3+3). of Cylinder size of N2O Emergency cylinder manifold complete with NRVs & Pig tail pipes. (Cylinder will be provided by the Hospital)	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
4	Nitrous Oxide Gas Outlets	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
5	Nitrous Oxide High-Pressure Rubber tube blue colour.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
C	Carbon Dioxide	
1	(5+5). Cylinder size of Primary & Secondary Main Carbon Dioxide Manifold complete with NRVs and pig tailpipes. (Cylinder will be provided by the Hospital)	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
2	Fully Automatic control panel for Carbon Dioxide Having a min. flow output of 1000 LPM at 4.2 bar pressure with a heating mechanism	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
3	Carbon Dioxide Gas Outlets with the probe	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
4	Carbon Dioxide High-Pressure Rubber tube	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
D	Vacuum	
1	Quadruplex Vacuum Central System Complete with 04 nos. Vacuum Pump, each having minimum 3250 lpm with Filter, interconnecting pipes, NRV, auto switch gear assy., exhaust silencer. (6500 LPM primary + 6500 LPM Secondary)	Busch / Anestiwata / Ingersoll Rand/ Beacon Medaes
2	Vacuum Receiver of 4000 Ltrs Capacity.	As per OEM recommendation

List of Makes for MGPS

S.No	Description of Items	Makes
3	Bacterial Filter	Parker / Dominik Hunter/ Walker Filtration
4	Vacuum Gas Outlets.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
5	Ward Vacuum Unit with Regulator, Collection Jar of 600 ml with Bracket.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
6	Theatre vacuum unit trolley mounted complete with 1no. of high suction regulator along with twin vacuum collection jar of Polysulphone / Polycarbonate of 2000ml with lid.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
7	Vacuum High-Pressure Rubber tube red colour.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
8	Vacuum Low-Pressure Rubber tube	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
E	Medical Air	
1	Quadruplex Compressed Air system complete with minimum capacity 04 nos. of oil lubricated rotary screw Compressors, Air-cooled type Base Frame mounted Air compressors with 4000 LPM Capacity for MA4	Anestiwata / Ingersoll Rand / Altas Copco
2	MA4 Receiver of Capacity 4000 Ltrs	As per OEM recommendation
3	4-stage Air Filtration System	Parker / Dominik Hunter/ Walker Filtration
4	Pressure Reducing System	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
5	Medical Air 4 Bar Gas Outlets	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
6	Surgical Air 7 Bar Gas Outlets	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
7	Compressed Air High Pressure Rubber tube colour.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv

List of Makes for MGPS

S.No	Description of Items	Makes
F	AGSS	
1	Duplex Anaesthetic Gas Scavenging System (1 running + 1 standby)-each pump capacity of a minimum 1200 LPM with the inbuilt control panel of the system	Ohio medical / Beacon Medaes/ Trittech
2	AGSS Gas Outlets.	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
3	AGSS High-Pressure Rubber tube	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
G	Electrical Control Panel	
1	Combined Electrical Control Panel for Vacuum System and compressed Air System complete with plant Room wiring.	Schematic/Havells/Schneider/Siemens
H	Medical Grade Copper Tube/Pipes :	
1	108 mm OD x 1.2 mm thick	Mehta/ Rajco/ Mandev
1	76 mm OD x 1.2 mm thick	Mehta/ Rajco/ Mandev
2	54 mm OD x 1.2 mm thick	Mehta/ Rajco/ Mandev
3	42 mm OD x 1.2 mm thick	Mehta/ Rajco/ Mandev
4	28 mm OD x 0.9 mm thick	Mehta/ Rajco/ Mandev
5	22 mm OD x 0.9 mm thick	Mehta/ Rajco/ Mandev
6	15 mm OD x 0.9 mm thick	Mehta/ Rajco/ Mandev
7	12 mm OD x 0.7 mm thick	Mehta/ Rajco/ Mandev
I	Digital Medical Gas Alarm System :	

List of Makes for MGPS

S.No	Description of Items	Makes
1	6 gases	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
2	4 gases	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
3	3 gases	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
4	2 gases	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
J	Area Valve Box with Pressure Gauge:	
1	6 gases	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
2	4 gases	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
3	3 gases	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
4	2 gases	Drager / Ohio / Amico / Beacon Medaes/ Aktiv
K	Degreased Medical Ball Valve	
1	22 MM.	RB Italy/CIM Italy/RN
2	28 MM.	RB Italy/CIM Italy/RN
3	42 MM.	RB Italy/CIM Italy/RN
4	54 MM.	RB Italy/CIM Italy/RN
5	76 MM.	RB Italy/CIM Italy/RN
L	Bed-Head Panel	
1	2 Gas Out-Let BHP	Drager / Aktiv / Altos
2	3 Gas Out-Let BHP	Drager / Aktiv / Altos
3	6 Gas Out-Let BHP	Drager / Aktiv / Altos
M	Pressure Reducing Stations	
1	Pressure Reducing Stations	Drager / Ohio / Amico / Beacon Medaes/ Aktiv

PART- D

SUB- HEAD : FINISHING SCHEDULE FOR

- a) HOSPITAL BLOCK**
- b) RESIDENTIAL BLOCK**
- c) RESEARCH & DEVELOPMENT BLOCK**
- d) MISCELLANEOUS AREA**

FINISHING SCHEDULE FOR HOSPITAL BLOCK

FINISHING SCHEDULE (COMMON AREAS)

HOSPITAL BLOCK ROOM LIST- COMMON AREAS

S. NO.	ROOM DETAILS	Floor	Skirting	Wall	Ceiling	Counter
1	OPD & EMERGENCY MAIN ENTRANCE WAITING LOBBY	15 MM THK ENGINEERED MARBLE STONE TILES WITH SEEMLESS JOINT FIXED WITH MORTAR AS/ SPECS	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	PRE LAM BOARD (12 MM THK) +LACQUERED GLASS +1050 MM HIGH RIGID PVC SHEET (1 MM THK) (REFER DRAWINGS) + ANTI BACTERIAL PAINT	100X50 GI (Wooden texture) LAMINATED BAFFLES LOUVERS WITH 600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
2	PUBLIC LOBBY (TOWER 1)	2 SHADE OF 15MM THK ENGINEERED MARBLE STONE TILES WITH SEEMLESS JOINT FIXED WITH MORTAR AS/ SPECS	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE ANTI BACTERIAL PAINT WITH HANDRAIL IN THE CORRIDOR (AS PER DRWAING)	..... ..	..... .....
3	ADMIN TPA COUNTER	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM VITRIFIED TILES ALIGNED WITH FLOORING	RIGID PVC SHEET (1 MM THK) TILL BOTTOM OF FALSE CEILING WITH ABOVE ANTI BACTERIAL PAINT. (AS PER DRWAING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	WOODEN LAMINATE D FINISH
4	OPD WAITING AREA GF FLOOR (TOWER 2)	600X600 MM VITRIFIED TILES FIXED WITH ENGINEERED MARBLE STONE TILES WITH SEEMLESS JOINT FIXED WITH MORTAR AS/SPECS	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE ANTI BACTERIAL PAINT. (AS PER DRWAING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
5	TYPICAL WAITING AREA FIRST FLOOR TO SIXTH FLOOR (TOWER 1)	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE ANTI BACTERIAL PAINT. (AS PER DRWAING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

6	TYPICAL WAITING AREA FIRST FLOOR TO SIXTH FLOOR (TOWER 2)	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE ANTI BACTERIAL PAINT. (AS PER DRWAING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
7	LIFT LOBBY TOWER 1	15 MM THK ENGINEERED MARBLE STONE TILES WITH BAND OF 200 OF ENGINEERED MARBLE SHADE 2 , WITH SEEMLESS JOINT FIXED WITH MORTAR AS/ SPECS	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	LIFT SIDE WALL : BAND OF 200MM OF ENGINEERED MARBLE (15 MM THK) (Architrave) + RIGID PVC SHEET (1 MM THK) TILL 2250 WITH 5 MM GROOVES + PAINT AS/ DESIGN LIFT OPP SIDE : PAINT AS/ SELECTED SHADE SPECS +100mm SKIRTING OF SAME FINISH OF FLOORING (AS PER DRAWING)	GYPSUM BOARD CEILING	..........
8	LIFT LOBBY TOWER 2 OPD SIDE	15 MM THK ENGINEERED MARBLE STONE TILES WITH BAND OF 200 OF 15 MM THK ENGINEERED MARBLE SHADE 2 , WITH SEEMLESS JOINT FIXED WITH MORTAR AS/ SPECS	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	LIFT SIDE WALL : BAND OF 200MM OF ENGINEERED MARBLE (15 MM THK) (Architrave) +RIGID PVC SHEET (1 MM THK) TILL 2250 WITH 5 MM GROOVES + PAINT AS/ DESIGN LIFT OPP SIDE GF: RIGID PVC SHEET TILL 750 MM + PAINT AS/ SELECTED SHADE SPECS LIFT OPP SIDE TYP FLOOR : PAINT AS/ SELECTED SHADE SPECS +100mm SKIRTING OF SAME FINISH OF FLOORING (AS PER DRAWING)	GYPSUM BOARD CEILING	..........

9	LIFT LOBBY TOWER 2 CENTRAL CORE SIDE	600X600 MM VITRIFIED TILES FIXED WITH 15 MM THK ENGINEERED MARBLE STONE TILES WITH SEEMLESS JOINT FIXED WITH MORTAR AS/SPECS	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	LIFT SIDE WALL : BAND OF 200MM OF ENGINEERED MARBLE(Architrave) + RIGID PVC SHEET TILL 2250 WITH 5 MM GROOVES + PAINT AS/ DESIGN LIFT OPP SIDE : PAINT AS/ SELECTED SHADE SPECS +100mm SKIRTING OF SAME FINISH OF FLOORING (AS PER DRAWING)	GYPSUM BOARD CEILING	..........
10	LIFT LOBBY TOWER 3	600X600 MM VITRIFIED TILES FIXED WITH 15 MM THK ENGINEERED MARBLE STONE TILES WITH SEEMLESS JOINT FIXED WITH MORTAR AS/SPECS	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	LIFT SIDE WALL : BAND OF 200MM OF ENGINEERED MARBLE(Architrave) + RIGID PVC SHEET TILL 2250 WITH 5 MM GROOVES + PAINT AS/ DESIGN LIFT OPP SIDE : PAINT AS/ SELECTED SHADE SPECS +100mm SKIRTING OF SAME FINISH OF FLOORING (AS PER DRAWING)	GYPSUM BOARD CEILING	..........

NOTE- FOR CT SCAN . X-RAY, MRI ,AERB
GUIDELINES SHOULD BE FOLLOW.

NOTE- TOILET AND PANTRY FLOOR TILE ARE
ANTI SKID TILES

NOTE- THE EDGES OF THE MDF BOARD SHALL BE COVERED WITH WOODEN LIPPING. THE LIPPING
CAN BE OF WIDTH VARY FROM 12MM TO 25 MM AS/REQUIREMENT.

NOTE- THE COUNTER TOP FOR THE TOILET WILL
BE MADE OF LIGHT SHADED GRANITE

NOTE -Use pvc corner profile above dado finish where height of
dado finish is below 2250 mm

NOTE : Contractor need to provide trap doors in case of plain calcium silicate/
gypsum board false ceiling where ever required(as/mep).

NOTE : IN CASE OF UNDULATION IN WALL ALINGMENT METAL
CLAMPS/HANGERS CAN BE USED FOR MDF BOARD

NOTE : AT GROUND FLOOR WHERE EVER VINYL FLOORING IS
USED IN FLOORING WATERPROFFING IS NECESSARY.

FINISHING SCHEDULE (TOWER 1 & TOWER 2)						
HOSPITAL BLOCK ROOM LIST (TOWER-01 & TOWER-02) - GROUND FLOOR						
S. NO	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
TOWER-01						
1	AHU ROOM-1	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	............
2	ISOLATION ROOM - DIALYSIS	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	...........
3	DIALYSIS WARD					
4	DIALYSIS CHANGE ROOM					
5	NURSE STATION- DIALYSIS	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	...........
6	WAITING LOBBY					
7	CONSULTANT ROOM	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	EXAMINATION BED - PRE LAMINATED BOARD (12 MM THK) TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: - ANTIBACTERIAL PAINT TILL FALSE CEILING. (AS PER DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... ..... .
8	NURSE DUTY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM	...........
9	DOCTOR DUTY					
10	NURSE DUTY					

		EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS			SILICATE BOARD.	
11	DIALYSER	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	.....
12	DIALYSATE					.....
13	FLUID MAKING					.
14	DAY CARE	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	
15	NURSE STATION - DAY CARE	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	..... .....	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC

16	SCOPE CLEANING	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	..... .....	600X600 MM VITRIFIED TILES TILL 2250 MM HIGH , FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	..... ..... ..
17	SCOPE STORAGE						
18	CLEAN UTILITY -GF	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: - 600 x 600 MM VITRIFIED TILES TILL 1200 MM	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS /DRAWING	
19	DIRTY UTILITY -GF						
20	GI ENDOSCOPY	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..... ..... ..
21	CAPSULE ENDOSCOPY						
22	STAFF ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... ..... ..
23	STORE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING.	OIL BOUND DISTEMPER	..... ..... ..
24	STORE ROOM						
25	KITCHEN	AS/VENDOR DRAWING					

26	MANAGER	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... ..... ..
27	LAUNDARY	AS/VENDOR DRAWING				
28	GENERAL STORE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	OIL BOUND DISTEMPER	............
29	MEDICAL CONSUMABLE STORE	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	............
30	EQUIPMENT STORE					
31	STAFF CHANGE MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	...........
32	STAFF CHANGE FEMALE					
33	CHANGE ROOM					
34	CHANGE ROOM					
35	MAIN LV ROOM	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	............
36	PUBLIC MALE TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
37	PUBLIC FEMALE TOILET					
38	PUBLIC MALE TOILET					
39	PUBLIC FEMALE TOILET					

40	NURSE DUTY- TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD	POLISHED GRANITE EDGE MOULDED COUNTER
41	DOCTOR DUTY - TOILET				
42	STAFF TOILET MALE					
43	CORRIDOR- GROUND FLOOR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.
TOWER-02						
44	PUBLIC TOILET FEMALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
45	PUBLIC TOILET MALE				
46	PUBLIC TOILET MALE					
47	CONSULTANT ROOM	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	EXAMINATION BED - PRE LAMINATED BOARD (12 MM THK) TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: - ANTIBACTERIAL PAINT TILL FALSE CEILING. (AS PER DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.
48	CONSULTANT ROOM				
49	CONSULTANT ROOM					
50	CONSULTANT ROOM					
51	CONSULTANT ROOM					
52	OPG					
53	CBCT					
54	CONSULTANT ROOM					
55	CONSULTANT ROOM					

56	AHU ROOM-02	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..............
57	VIP- WAITING AREA	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	.............
58	VIP - EXAMINATION ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600 x 600 MM VITRIFIED TILES TILL 1200 MM WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	PLAIN CALCIUM SILICATE BOARD	.............
59	VIP - TREATMENT ROOM		600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.			

HOSPITAL BLOCK ROOM LIST (TOWER-01 & TOWER-02) - FIRST FLOOR						
S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
TOWER-01						
60	22 BED ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	

61	NURSE STATION - ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
62	10 BED CCU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	
63	NURSE STATION - CCU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
64	COMMAND CENTRE - CCU					
65	CATH LAB	AS/VENDOR DRAWING				
66	PRE CATH AREA	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ABOVE THE SKIRTING ANTI BACTERIAL PAINT.	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

67	8 BED ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	
68	NURSE STATION - ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
69	COMMAND CENTRE - ICU					
70	COMMAND CENTRE - ICU					
71	STORE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	OIL BOUND DISTEMPER	..........
72	STORE ROOM					
73	UPS BATTERY ROOM	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........
74	COLLABORATION ROOM -WARD	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIA	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) (0.9 NRC) ACOUSTIC CEILING WITH CALCIUM SILICATE	..........

		L EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS			BOARD.	
75	DOCTOR DUTY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIA L EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	.....
76	NURSE DUTY					.....
77	NURSE DUTY					.....
78	SIDE LAB	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIA L EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	750 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
79	CHANGE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ABOVE THE SKITING ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD	.....
80	CHANGE ROOM					.....

		BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE				
81	DIRTY UTILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	.....	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: -600 x 600 MM VITRIFIED TILES TILL 1200 MM	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING
82	CLEAN UTILITY		.....		
83	CLEAN UTILITY					
84	DIRTY UTILITY					
85	CLEAN UTILITY					
86	DIRTY UTILITY					
87	EQUIPMENT ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

88	TREATMENT ROOM	600 x 600 MM	.....	600 x 600 MM	600X600 MM MFT(	.....
89	TREATMENT ROOM	VITRIFIED TILES WITH 2 MM	.....	VITRIFIED TILES TILL 1200 MM	MINERAL FIBRE) CEILING	.....
90	MEDICATION ROOM	SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS		WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	WITH CALCIUM SILICATE BOARD.	
91	PATIENT TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM	.....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING,	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
92	STAFF TOILET	SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS		AND ABOVE ANTI BACTERIAL PAINT.		
98	DOCTOR DUTY-TOILET					
99	NURSE DUTY-TOILET					
100	PATIENT TOILET MALE					
101	STAFF TOILET MALE					
103	PATIENT TOILET FEMALE					
104	CORRIDOR-FIRST FLOOR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	.....

105	ICU + CATH LAB CORRIDOR-FIRST FLOOR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO- GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
TOWER-02						
106	PHARMA STORE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIA L EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI- BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	..........
107	AHU ROOM -1	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMP ER	..........
108	STAFF TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIA L EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
109	STAFF TOILET FEMALE					
110	PATIENT TOILET MALE					
111	PATIENT TOILET FEMALE					

112	DEPARTMENT OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... ....
113	PROCEDURE ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	2100 MM HIGHRIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
114	DOPPLER	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	EXAMINATI ON BED - PRE LAMINATED BOARD (12 MM THK) TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: - ANTIBACTERIAL PAINT TILL FALSE CEILING. (AS PER DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... ....
115	ECHO/HOLTER					
116	STRESS TEST					
117	CONSULTANT ROOM					
118	ECG					
119	TERRACE -T2	GRANITE + 600 x 600 MM VITRIFIED TILES				.....

HOSPITAL BLOCK ROOM LIST (TOWER-01 & TOWER-02) - SECOND FLOOR						
S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
TOWER-01						
120	22 BED ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	
121	NURSE STATION - ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
122	COMMAND CENTRE - ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
123	COMMAND CENTRE - ICU					

124	PUBLIC MALE TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT..	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
125	PUBLIC FEMALE TOILET					
126	PHT					
127	TOILET					
128	DOCTOR DUTY - TOILET					
129	NURSE DUTY- TOILET					
130	STAFF TOILET MALE					
131	PATIENT TOILET					
132	HK					
133	STAFF TOILET FEMALE					
134	COLLABORATION ROOM - WARD	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) (0.9 NRC) ACOUSTIC CEILING WITH CALCIUM SILICATE BOARD.
135	TREATMENT ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600 x 600 MM VITRIFIED TILES TILL 1200 MM WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600X600 MM MFT(MINERAL FIBRE) (0.9 NRC) ACOUSTIC CEILING WITH CALCIUM SILICATE BOARD.
136	MEDICATION ROOM				

137	DOCTOR DUTY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	.....
138	NURSE DUTY					.....
139	NURSE DUTY					.....
140	SIDE LAB	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	750 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE ANTI BACTERIAL PAINT.	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	.....
141	MALE CHANGE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	.....
142	FEMALE CHANGE ROOM					.....

143	DIRTY UTILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: -600 x 600 MM VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING
144	CLEAN UTILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	.....	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
145	EQUIPMENT ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
146	PANTRY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM 2250 MM HIGH VITRIFIED TILES, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD	..........

147	CORRIDOR-SECOND FLOOR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
148	ICU CORRIDOR-SECOND FLOOR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
TOWER-02						
149	PHARMA STORE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
150	AHU ROOM -1	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........

151	STAFF TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	.....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
152	STAFF TOILET FEMALE		....		
153	PATIENT TOILET MALE					
154	PATIENT TOILET FEMALE					
155	DEPARTMENT OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... ....
156	IMMUNIZATION ROOM	600 x 600 MM VITRIFIED TILES (VT) WITH 2 MM SPACER AND GROUDED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	EXAMINATION BED - PRE LAMINATED BOARD (12 MM THK) TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: - ANTIBACTERIAL PAINT TILL FALSE CEILING. (AS PER DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... ....
157	CONSULTANT ROOM					

HOSPITAL BLOCK ROOM LIST (TOWER-01 & TOWER-02) - THIRD FLOOR						
S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
TOWER-01						
158	6 BED WARD	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	BED WALL - 600 x 600 MM VITRIFIED TILES TILL 1200 MM HEIGHT AND ABOVE 300 MM PRE LAMBOARD (12 MM THK) AND ABOVE 10 MM THICK GLASS CORRIDOR WALL - 1200 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE 10 MM THICK GLASS FRONT WALL (OPPOSITE TO ENTRY DOOR) - 600 x 600 MM VITRIFIED TILES TILL 1200 MM HEIGHT AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..... .....
159	6 BED WARD					
160	HDU					
161	HDU					
162	NURSE STATION -WARD	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
163	NURSE STATION - WARD					

164	22 BED ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
165	NURSE STATION - ICU					
166	COMMAND CENTRE- ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
167	PUBLIC MALE TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
168	PUBLIC FEMALE TOILET					
169	PATIENT TOILET FEMALE					
170	PATIENT TOILET					
171	PATIENT TOILET MALE					
172	DOCTOR DUTY - TOILET					
173	NURSE DUTY-TOILET					
174	PHT					
175	STAFF TOILET MALE					
176	STAFF TOILET FEMALE					
177	HEAD NURSE - TOILET					
178	HK					

179	TOILET					
180	NURSE DUTY ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.
181	DOCTOR DUTY					
182	NURSE DUTY					
183	HEAD NURSE ROOM					
184	CLEAN UTILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: - 600 x 600 MM VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRA WING
185	DIRTY UTILITY					
186	DIRTY UTILITY					
187	CLEAN UTILITY					
188	COLLABORATION ROOM	2 MM THK VINYL FLOORING	150 MM HIGH VINYL FLOORING (2 MM THK)	FRONT WALL (OPPOSITE TO ENTRY DOOR) - 2100 MM HIGH PRE LAMINATED BOARD (12 MM THK) +ABOVE ANTI BACTERIAL PAINT TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: -ANTI-BACTERIAL PAINT TILL FALSE CEILING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.
189	STORE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	OIL BOUND DISTEMPER

190	MEDICATION ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND	..... .....	600 x 600 MM VITRIFIED TILES TILL 1200 MM WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
191	MEDICATION ROOM	GROUTED WITH ANTI BACTERIAL EPOXY				
192	TREATMENT ROOM	GROUT. TILE				
193	TREATMENT ROOM	FIXED WITH ADHESIVE AS PER SPECS				
194	EQUIPMENT ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
195	MALE CHANGE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	..........
196	PANTRY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM 2250 MM HIGH VITRIFIED TILES, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD	..........
197	CORRIDOR-THIRD TO FIFTH FLOOR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

198	ICU CORRIDOR-THIRD TO FIFTH FLOOR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
199	ENTRANCE LOBBY - TERRACE	GRANITE + 600 x 600 MM VITRIFIED TILES				..... .....
TOWER-02						
200	WAITING - T-2					
201	PHARMA STORE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
202	AHU ROOM -1	550 X 550 X 20 MM THICK POLISHED KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........
203	STAFF TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
204	STAFF TOILET FEMALE					
205	PATIENT TOILET MALE					
206	PATIENT TOILET FEMALE					
207	DEPARTMENT OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

208	PROCEDURE ROOM	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	EXAMINATION BED - PRE LAMINATED BOARD (12 MM THK) TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: - ANTIBACTERIAL PAINT TILL FALSE CEILING. (AS PER DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	.....
209	PLASTER ROOM					.....
210	BERA					
211	UROFLOM. ROOM					
212	URODYNAMICS ROOM					
213	CONSULTANT ROOM					

HOSPITAL BLOCK ROOM LIST (TOWER-01 & TOWER-02) -FOURTH & FIFTH						
S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
TOWER-01						
214	6 BED WARD	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	.....	BED WALL - 600 x 600 MM VITRIFIED TILES TILL 1200 MM HEIGHT AND ABOVE 300 MM PRE LAMBOARD AND ABOVE 10 MM THICK GLASS CORRIDOR WALL - 1200 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE 10 MM THICK GLASS FRONT WALL (OPPOSITE TO ENTRY DOOR) - 600 x 600 MM VITRIFIED TILES TILL 1200 MM HEIGHT AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	.....
215	6 BED WARD					
216	HDU					
217	HDU					

218	NURSE STATION -WARD	600 x 600 MM VITRIFIED TILES WITH 2 MM	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
219	NURSE STATION - WARD	SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS				
220	PUBLIC MALE TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM	..... ..	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
221	PUBLIC FEMALE TOILET	SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY				
222	PATIENT TOILET FEMALE	GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS				
223	PATIENT TOILET					
224	PATIENT TOILET MALE					
225	DOCTOR DUTY - TOILET					
226	NURSE DUTY-TOILET					
227	PHT					
228	STAFF TOILET MALE					
229	STAFF TOILET FEMALE					
230	HEAD NURSE - TOILET					
231	HK					
232	TOILET					
233	NURSE DUTY ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .
234	DOCTOR DUTY	SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY				
235	NURSE DUTY	GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS				
236	HEAD NURSE ROOM					

237	CLEAN UTILITY - 4TH TO 5TH	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: - 600 x 600 MM VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING
238	DIRTY UTILITY - 3RD TO 5TH	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: - 600 x 600 MM VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING
239	DIRTY UTILITY - 3RD TO 5TH					
240	CLEAN UTILITY - 3RD TO 5TH					
241	COLLABORATION ROOM						2 MM THK VINYL FLOORING	150 MM HIGH VINYL FLOORING (2 MM THK)	FRONT WALL (OPPOSITE TO ENTRY DOOR) - 2100 MM HIGH PRE LAMINATED BOARD (12 MM THK) + ABOVE ANTI BACTERIAL PAINT TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: - ANTI-BACTERIAL PAINT TILL FALSE CEILING	600X600 MM MFT( MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .
242	STORE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	OIL BOUND DISTEMPER
243	MEDICATION ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600 x 600 MM VITRIFIED TILES TILL 1200 MM WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD
244	MEDICATION ROOM					
245	TREATMENT ROOM					
246	TREATMENT ROOM					

247	EQUIPMENT ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .
248	MALE CHANGE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	..........
249	PANTRY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM 2250 MM HIGH VITRIFIED TILES, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD	..........
250	CORRIDOR-THIRD TO FIFTH FLOOR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

251	ICU CORRIDOR- FOURTH TO FIFTH FLOOR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
252	ENTRANCE LOBBY - TERRACE	GRANITE + 600 x 600 MM VITRIFIED TILES				..... .....
TOWER-02						
253	WAITING - T-2					
254	PHARMA STORE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
255	AHU ROOM -1	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	......
256	STAFF TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... ..	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
257	STAFF TOILET FEMALE					
258	PATIENT TOILET MALE					
259	PATIENT TOILET FEMALE					
260	DEPARTMENT OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .

261	PROCEDURE ROOM	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	EXAMINATION BED - PRE LAMINATED BOARD (12 MM THK) TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: - ANTIBACTERIAL PAINT TILL FALSE CEILING. (AS PER DRAWING)	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.
262	PLASTER ROOM					
263	BERA					
264	UROFLOM. ROOM					
265	URODYNAMICS ROOM					
266	CONSULTANT ROOM					

HOSPITAL BLOCK ROOM LIST (TOWER-01 & TOWER-02) -SIXTH FLOOR						
S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
TOWER-01						
267	6 BED WARD	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	BED WALL - 600 x 600 MM VITRIFIED TILES TILL 1200 MM HEIGHT AND ABOVE 300 MM PRE LAMBOARD AND ABOVE 10 MM THICK GLASS CORRIDOR WALL - 1200 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE 10 MM THICK GLASS FRONT WALL (OPPOSITE TO ENTRY DOOR) - 600 x 600 MM VITRIFIED TILES TILL 1200 MM HEIGHT AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........

268	NURSE STATION-WARD	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
269	NURSE STATION - WARD	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
270	PUBLIC MALE TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
271	PUBLIC FEMALE TOILET					
272	PATIENT TOILET FEMALE					
273	DOCTOR DUTY - TOILET					
274	NURSE DUTY-TOILET					
275	HEAD NURSE- TOILET					
276	PATIENT TOILET MALE					
277	STAFF TOILET FEMALE					
278	HK					
279	NURSE DUTY ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.
280	DOCTOR DUTY					
281	HEAD NURSE ROOM					
282	CLEAN UTILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: -	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING

283	DIRTY UTILITY	EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS		600 x 600 MM VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)		
284	COLLABORATION ROOM	2 MM THK VINYL FLOORING	150 MM HIGH VINYL FLOORING (2 MM THK)	FRONT WALL (OPPOSITE TO ENTRY DOOR) - 2100 MM HIGH PRE LAMINATED BOARD (12 MM THK) + ABOVE ANTI BACTERIAL PAINT TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: -ANTI-BACTERIAL PAINT TILL FALSE CEILING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
285	PNEUMATIC PLANT	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	......
286	TREATMENT ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... ..	600 x 600 MM VITRIFIED TILES TILL 1200 MM WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .
287	MEDICATION ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... ..	600X300 MM 2250 MM HIGH VITRIFIED TILES, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD	......
288	PANTRY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... ..	600X300 MM 2250 MM HIGH VITRIFIED TILES, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD	......

289	FEMALE CHANGE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	......
290	MALE CHANGE ROOM					
291	MEDICAL RECORD	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .
292	STORE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	OIL BOUND DISTEMPER	......
293	STORE ROOM					
294	MEETING ROOM - ENGINEERING SECTION	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .
295	OFFICE -ENGINEERING SECTION					
296	ENGINEERING SECTION					

297	OFFICE - ADMIN	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .
298	MEETING ROOM - ADMIN	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .
299	ADMIN					
300	OFFICE -ADMIN					
301	OFFICE - ADMIN					
TOWER-02						
302	MANAGER ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	......
303	PHARMA STORE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .
304	PATIENT TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... ..	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
305	PATIENT TOILET FEMALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... ..	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER

306	MEETING ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	750 MM HIGH PRE-LAM BOARD (12 MM THK) WITH ABOVE 1350 MM HIGH FABRIC PANEL (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MODULAR MFT (0.9 NRC) ACOUSTIC CEILING TILES WITH WITH CALCIUM SILICATE BOARD.	..... .
307	AHU ROOM -1	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	......
308	SPARE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	......
309	OFFICE					
310	SENIOR OFFICE ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	.....
311	CONFERENCE ROOM	2 MM THK VINYL FLOORING	..... ..	750 MM HIGH PRE-LAM BOARD (12 MM THK) WITH ABOVE 1350 MM HIGH FABRIC PANEL (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MODULAR MFT (0.9 NRC) ACOUSTIC CEILING TILES WITH WITH CALCIUM SILICATE BOARD.	..... .
312	CORRIDOR-SIXTH FLOOR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING.	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .

NOTE- FOR CT SCAN . X-RAY, MRI ,AERB
GUIDELINES SHOULD BE FOLLOW.

NOTE- TOILET AND PANTRY FLOOR TILE ARE
ANTI SKID TILES

NOTE- THE EDGES OF THE MDF BOARD SHALL BE COVERED WITH WOODEN LIPPING. THE
LIPPING CAN BE OF WIDTH VARY FROM 12MM TO 25 MM AS/REQUIREMENT.

NOTE- THE COUNTER TOP FOR THE TOILET
WILL BE MADE OF LIGHT SHADED GRANITE

NOTE -Use pvc corner profile above dado finish where height of
dado finish is below 2250 mm

NOTE : Contractor need to provide trap doors in case of plain calcium silicate/
gypsum board false ceiling where ever required(as/mep).

NOTE : IN CASE OF UNDULATION IN WALL ALINGMENT METAL
CLAMPS/HANGERS CAN BE USED FOR MDF BOARD

NOTE : AT GROUND FLOOR WHERE EVER VINYL FLOORING IS
USED IN FLOORING WATERPROFFING IS NECESSARY.

FINISHING SCHEDULE (TOWER 3)

HOSPITAL BLOCK ROOM LIST- TOWER 3 (GROUND FLOOR)

S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
1	INTENSIVE CARE AREA	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	BED HEAD WALL :- 1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT. REST OF WALLS :- 1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	.....
2	INTENSIVE CHANGING ROOM					.....
3	NURSE STATION - TRIAGE					
4	TRIAGE AREA					
5	STORE-1 EMERGENCY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	OIL BOUND DISTEMPER	.....
6	STORE-2					.....
7	STAFF ROOM-EMERGENCY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	.....
8	CLEAN UTILITY-EMERGENCY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS	.....	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: - 600 x 600 MM	PLAIN CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING
9	DIRTY UTILITY - EMERGENCY						ADHESIVE AS

		PER SPECS		VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)		
10	UPS BATTERY ROOM	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........
11	CADAVER STORE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	..... .....
12	OBSERVATION ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600 MM X600 MM BIO- GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
13	DEXA	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
14	AHU-1	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........
15	MAMOGRAPHY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

			ABOVE)			
16	MRI	AS/VENDOR DRAWING				
17	U/S WITH DOPPLER	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	..... .....
18	U/S WITH DOPPLER-TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD.	..... .....
19	PACS ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
20	REPORTING TECH					
21	AHU-2	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........
22	DONOR ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........

23	AUTOCLAVE	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	.....
24	TTI LAB					.....
25	HEMATOLOGY LAB					
26	APHERESIS					
27	COMPONANT LAB					
28	BLOOD ISSUE					
29	BLOOD STORAGE	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	.....
30	COMPONENT STORAGE					.....
31	WAITING GF	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	.....
32	REFRESH ROOM					.....
33	COUNSELLING & EXAM ROOM					
34	ADMIN RECORD ROOM					
35	WAITING ROOM-GF					
36	COUNSELLING ROOM					
37	FLURO ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	.....
38	FLURO ROOM - READING ROOM					.....
39	FLURO ROOM-TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD.	..... .....

40	FLURO ROOM- CHANGE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	..... .....
41	SUB REGISTER	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
42	SUB REGISTER - OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
43	SAMPLE COLLECTION	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
44	PHARMACY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
45	PHARMACY STORAGE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

46	CT SCAN (INTERIOR AS PER AERB NORMS)	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600 MM X600 MM BIO- GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
47	PHT TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
48	JANITOR ROOM					
49	PUBLIC FEMALE TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
50	PUBLIC MALE TOILET					
51	AHU-3	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........
52	EQUIPMENT PANEL ROOM	551 X 550 X 20 MM THICK POLISHED KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........
53	MINOR TREATMENT ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1100 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	..... .....

54	XRAY ROOM (INTERIOR AS PER AERB NORMS)	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600 MM X600 MM BIO- GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD
55	OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.
56	NURSE DUTY					
57	DOCTOR DUTY ROOM					
58	STAFF TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
59	STAFF TOILET FEMALE					
60	PAT TOILET MALE					
61	PAT TOILET FEMALE					
62	CONSULTANT ROOM		600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS				150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. ( ONLY WHERE PAINT ON WALL ABOVE)	EXAMINATIO N BED - PRE LAMINATED BOARD (12 MM THK ) TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS - ANTIBACTERIA L PAINT TILL FALSE CEILING. (AS PER DRAWING)	600X600 MM MFT( MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

63	POLICE BOOTH	600 x 600 MM VITRIFIED TILES (VT)WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	..........	..........
64	BLOOD BANK CORRIDOR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
65	DIAGNOSTIC CORRIDOR AND OTHER CORRIDORS	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

HOSPITAL BLOCK ROOM LIST-TOWER 3 (FIRST FLOOR)

S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
66	LOUNGE - OT	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	PRE LAMINATED BOARD (12 MM THK) TILL 1050 MM HIGH+ABOVE ANTI BACTERIAL PAINT TILL FALSE CEILING AS/DESIGN.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
67	ORDERNLY LOUNGE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

68		AS/VENDOR DRAWING				
69	STERILE STORE	2 MM THK VINYL FLOORING	.....	1 MM THK VINYL TILL BOTTOM OF FALSE CEILING AS/DESIGN	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	.....
70	OT DOCUMENT ROOM		.....			.....
71	INTEGRATION ROOM					
72	SERVICE AREA (GROUND TO SIXTH)	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	.....
73	STAFF ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	.....
74	TSSU	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	.....
75	STAFF TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	.....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
76	STAFF TOILET FEMALE		.....		

77	BIO-MEDICAL	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
78	FLUID STORE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
79	LINEN STORE					
80	ANESTHETIST ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	FRONT WALL (OPPOSITE TO ENTRY DOOR) - PRE LAMINATED BOARD (12 MM THK) TILL 1050MM HIGH+ABOVE ANTI BACTERIAL PAINT TILL FALSE CEILING AS/DESIGN. REST OF THE WALLS & ENTRANCE DOOR WALL: -ANTI-BACTERIAL PAINT TILL FALSE CEILING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
81	NURSE DUTY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
82	DOCTOR DUTY					
83	STORE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	..........
84	STORE-1					

85	DOCTOR TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
86	DOCTOR TOILET FEMALE					
87	NURSE TOILET FEMALE					
88	NURSE TOILET MALE					
89	STAFF TOILET FEMALE					
90	STAFF TOILET MALE					
91	CSSD	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	ANTI-BACTERIAL PAINT OVER SKIRTING	..........	..........
92	AR/VR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
93	EQUIP ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
94	FROZEN SECTION	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	600X300 MM VITRIFIED TILES FIXED TILL 1200 MM HIGH WITH ADHESIVE AS PER SPECS. AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

95	MANAGER ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
96	DEMO ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) (0.9 NRC) ACOUSTIC CEILING WITH CALCIUM SILICATE BOARD.	..... .....
97	PRE OP	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
98	POST OP					
99	NURSE STATION - PRE POST OP					
100	ICU					
101	TRANSPLANT ISOLATION - ICU					
102	CLEAN UTILITY - POST OP	2 MM THK VINYL FLOORING	..... ..... .....	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: -600 x 600 MM VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING
103	DIRTY UTILITY - POST OP					
104	NURSE STATION - ICU	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	..... .....	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH

						SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
105	OT CORRIDOR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH		600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
106	ANESTHETIST CORRIDOR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)		600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....

HOSPITAL BLOCK ROOM LIST-TOWER 3 (SECOND FLOOR)						
S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
107	STAFF ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	..... .....
108	NICU & NURSERY	2 MM THK VINYL FLOORING	..... .....	1 MM THK VINYL TILL BOTTOM OF FALSE CEILING AS/DESIGN	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
109	NURSE STATION - NICU					
110	RECOVERY ROOM					
111	STERILE STORE					
112	SUPPORT ROOM					
113	LABOUR ROOM					
114	LDR ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	BED WALL - TILL 750 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 1350 MM HIGH PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT. REST OF THE WALL - ANTI BACTERIAL PAINT	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
115	PREPARATION ROOM	2 MM THK VINYL FLOORING	..... .....	1 MM THK VINYL TILL 1200 MM HIGH WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........

116	OT-10	AS/VENDOR DRAWING				
117	STORE-1	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	..... .....
118	CLEAN UTILITY - LDR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: - 600 x 600 MM VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)	PLAIN CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING
119	DIRTY UTILITY - LDR					
120	TOILET -LABOUR ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
121	TOILET LDR					
122	TOILET- ECLAMSIA ROOM					
123	TOILET -PREPARATION ROOM					
124	CHANGING ROOM-1 LDR					
125	CHANGING ROOM-2 LDR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	..... .....
126	ECLAMSIA ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON	1050 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 300 MM PRELAM BOARD (12 MM THK) AND ABOVE ANTI	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	..... .....

		ADHESIVE	WALL ABOVE)	BACTERIAL PAINT.		
127	NURSE STATION -LDR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
128	MILK ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	.....
129	MOTHER ROOM					.....
130	HISTOPATH LAB-TB ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	..... ..... ...	600 x 600 MM VITRIFIED TILES TILL 1200 MM WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
131	HISTOPATH LAB-CHANGING TB ROOM					
132	HISTOPATH LAB-FUNGAL CULTURE					
133	HISTOPATH LAB-VIRAL CULTURE					
134	HISTOPATH LAB-BACTERIOLOGY					
135	HISTOPATH LAB-AUTOMATED MICROBIOLOGY					

136	HISTOPATH LAB- AUTOMATED & MANUAL SEROLOGY					
137	HISTOPATH LAB- CLINICAL PATHOLOGY					
138	HISTOPATHOLOGY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	..... ..... ...	600 x 600 MM VITRIFIED TILES TILL 1200 MM WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
139	HISTOPATH LAB- FLOW CYTOMETRY					
140	CORE LAB - SAMPLE RECEIVING AREA					
141	CORE LAB -CONTROL ROOM					
142	CORE LAB					
143	HISTOPATH LAB- TOILET - HOD OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
144	HISTOPATH LAB- HOD OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	..... .....
145	CORE LAB - HOD OFFICE					
146	SERVICE AREA	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........

147	OT CORRIDOR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
148	LAB CORRIDOR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	..... .....
149	OUTER LOBBY TERRACE	GRANITE FLOORING + 600 x 600 MM VITRIFIED TILES				..... .....

HOSPITAL BLOCK ROOM LIST-TOWER 3 (THIRD FLOOR)						
S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
150	DOUBLE BEDDED WARD	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	BED WALL - TILL 750 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 1350 MM HIGH PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT. REST OF THE WALL - ANTI BACTERIAL PAINT	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	.....
151	DOUBLE BEDDED WARD					.....
152	SINGLE BEDDED WARD					.....
153	PAT. TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	.....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
154	PAT. TOILET		.....		
155	PAT. TOILET		.....		
156	PAT. TOILET		.....		
157	STAFF ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	.....
158	NURSE DUTY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	.....
159	DOCTOR DUTY					.....

160	STORE-1	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	OIL BOUND DISTEMPER	..........
161	NURSE STATION - WARD	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH		600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC
162	CLEAN UTILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... ..... ..	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: - 600 x 600 MM VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)	PLAIN CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING
163	DIRTY UTILITY					
164	PRIVATE WARD CORRIDOR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
165	LANDSCAPE TERRACE	GRANITE FLOORING + 600 x 600 MM VITRIFIED TILES				..... .....

HOSPITAL BLOCK ROOM LIST-TOWER 3 (FOURTH FLOOR)						
S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
166	GYMNASIUM	6 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MODULAR MFT (0.9 NRC) ACOUSTIC CEILING TILES WITH CALCIUM SILICATE BOARD	..........
167	MULTIPURPOSE ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.	..... .....
168	SEMINAR HALL	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	750 MM HIGH PRE-LAM BOARD (12 MM THK) WITH ABOVE 1350 MM HIGH FABRIC PANEL (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MODULAR MFT (0.9 NRC) ACOUSTIC CEILING TILES WITH CALCIUM SILICATE BOARD	..........
169	STAFF ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	..... .....
170	STAFF ROOM					

171	PHT TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
172	STAFF TOILET MALE					
173	STAFF TOILET FEMALE					
174	AHU-4	550 X 550 X 20 MM THICK KOTA STONE	150 MM HIGH POLISHED KOTA STONE SKIRTING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER	..........
175	CRYO UNIT	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	..... .....
176	ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD.	..... .....
177	NURSE STATION-BMT	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	..... .....	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	CUSTOM DESIGN COUNTER TO BE MADE OUT OF 12 MM THICK SOLID ACRYLIC SHEET (DUPONT CORIAN) . FIXED FURNITURE DESIGN TO BE MADE FORM INSIDE WITH SPACE PROVISION FOR NURSING NEEDS, COMPUTER ETC

178	CLEAN UTILITY-BMT	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	COUNTER SIDE -600 x 600 MM VITRIFIED TILES TILL 2250 MM REST OF THE WALLS & ENTRANCE DOOR WALL: - 600 x 600 MM VITRIFIED TILES TILL 1200 MM (AS PER COMMON DRAWING)	PLAIN CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER TOP WITH 300 MM WIDE FACIA ; - AS/SPECS/DRAWING
179	DIRTY UTILITY - BMT					
180	STORE - BMT					
181	PASS BOX ROOM-BMT	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
182	BMT ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	BED WALL - TILL 750 MM HIGH RIGID PVC SHEET (1 MM THK) WITH ABOVE 1350 MM HIGH PRELAM BOARD (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT. REST OF THE WALL - ANTI BACTERIAL PAINT	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
183	TOILET- BMT	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER

184	BMT CORRIDOR	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600 MM X600 MM BIO-GUARD (0.5 NRC MIN.) WITH CALCIUM SILICATE BOARD	..........
185	SERVER ROOM	600 MM HIGH ANTI-STATIC RAISED FLOORING	..... .....	ANTI-BACTERIAL PAINT OVER SKIRTING	OIL BOUND DISTEMPER	..........

HOSPITAL BLOCK ROOM LIST-TOWER 3 (FIFTH FLOOR)						
S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
STEM CELL THERAPY LAB						
186	CELL& ORGANOGENESIS FACILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	750 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING TILE WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
187	STERILE INSTRUMENTATION FACILITY					
188	INSTRUMENTATION FACILITY					
189	OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	
190	MEETING ROOM	2 MM THK VINYL FLOORING	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	600X600 MODULAR MFT (0.9 NRC) ACOUSTIC CEILING TILES WITH WITH CALCIUM SILICATE BOARD.	
191	LOUNGE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI- BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	

192	CHANGE ROOM MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	
193	CHANGE ROOM FEMALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	
194	CONFERENCE ROOM	2 MM THK VINYL FLOORING	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	750 MM HIGH PRE-LAM BOARD (12 MM THK) WITH ABOVE 1350 MM HIGH FABRIC PANEL (12 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MODULAR MFT (0.9 NRC) ACOUSTIC CEILING TILES WITH WITH CALCIUM SILICATE BOARD.	..... .....
195	CLASS ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MODULAR MFT (0.9 NRC) ACOUSTIC CEILING TILES WITH WITH CALCIUM SILICATE BOARD	..........
196	PHT TOILET	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER

197	PANTRY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM 2250 MM HIGH VITRIFIED TILES, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD	POLISHED GRANITE EDGE MOULDED COUNTER
198	STAFF TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... .....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
199	STAFF TOILET FEMALE					
IMMUNOTHERAPY LAB						
200	CELL CULTURE THERAPY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	750 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
201	STERILE INSTRUMENTATION FACILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	750 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
202	INSTRUMENTATION FACILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	750 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER

203	COLD ROOM	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	1050 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
204	OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	
205	OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	
MOLECULAR LAB						
206	POST PCR NGS SANGER CLEAN	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	750 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
207	NGS					
208	REAGENT PREP					
209	TARGET PREP					
210	POST PCR					
211	SAMPLE PREP					
212	PCR/RTPCR					
213	SANGER SEQUENCE					
CELL THERAPY LAB						
214	CELL CULTURE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	750 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
215	CELL THERAPY LAB - PASSAGE					
216	REAGENT ROOM					
217	FLOW CYTOMETRY					
218	STERILIZATION ROOM					

219	OPEN SITTING	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD	..........
220	CORRIDOR	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING. (ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD	..........

HOSPITAL BLOCK ROOM LIST-TOWER 3 (SIXTH FLOOR)

S. NO.	ROOM DETAILS	FLOOR	SKIRTING	WALL	CEILING	COUNTER
DATA CENTRE SUPER COMPUTER LAB LAB						
221	DATA CENTER SUPER COMPUTER	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING .(ONLY WHERE PAINT ON WALL ABOVE)	750 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	..... .....
222	NUERONAL LAB					
223	SENSORS MEDICAL DEVICE LAB					
224	OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING .(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	..........
225	OFFICE					
226	LOUNGE					

227	CHANGE ROOM MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING .(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	.....
228	CHANGE ROOM FEMALE					.....
229	CLASS ROOM	2 MM THK VINYL FLOORING	150 MM HIGH SKIRTING MATCHING WITH FLOOR FINISH	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MODULAR MFT (0.9 NRC) ACOUSTIC CEILING TILES WITH WITH CALCIUM SILICATE BOARD	.....
230	PANTRY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	..... ..... ....	600X300 MM 2250 MM HIGH VITRIFIED TILES, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE DADO ANTI BACTERIAL PAINT.	PLAIN CALCIUM SILICATE BOARD	POLISHED GRANITE EDGE MOULDED COUNTER
231	STAFF TOILET MALE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE AS PER SPECS	..... ..... ....	600X300 MM VITRIFIED TILES TILL BOTTOM OF FALSE CEILING, FIXED TO WALL WITH ADHESIVE AS PER SPECS. AND ABOVE ANTI BACTERIAL PAINT.	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
232	STAFF TOILET FEMALE					
233	PHT TOILET					
234	OFFICE	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING .(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	PLAIN CALCIUM SILICATE BOARD	.....
235	OFFICE					.....

GENE-THERAPHY LAB						
236	INSTRUMENTATION FACILITY	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING .(ONLY WHERE PAINT ON WALL ABOVE)	750 MM HIGH RIGID PVC SHEET (1 MM THK) AND ABOVE ANTI BACTERIAL PAINT	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	POLISHED GRANITE EDGE MOULDED COUNTER
237	STERILE INSTRUMENTATION FACILITY					
238	MOLECULAR OMICS					
239	ROBO SURGERY LAB					
240	OFFICE - ROBO SURGERY LAB					
241	GAIT LAB	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING .(ONLY WHERE PAINT ON WALL ABOVE)	1050 MM HIGH RIGID PVC SHEET (1 MM THK)AND ABOVE ANTI BACTERIAL PAINT	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	..... .....
242	OPEN SITTING	600 x 600 MM VITRIFIED TILES WITH 2 MM SPACER AND GROUTED WITH ANTI BACTERIAL EPOXY GROUT. TILE FIXED WITH ADHESIVE	150 MM HIGH VITRIFIED TILES TO ALIGN WITH FLOORING .(ONLY WHERE PAINT ON WALL ABOVE)	ANTI-BACTERIAL PAINT OVER SKIRTING	600X600 MM GI METAL CEILING WITH CALCIUM SILICATE BOARD.	..... .....

NOTE- FOR CT SCAN . X-RAY, MRI ,AERB GUIDELINES SHOULD BE FOLLOW.

NOTE- TOILET AND PANTRY FLOOR TILE ARE ANTI SKID TILES

NOTE- THE EDGES OF THE MDF BOARD SHALL BE COVERED WITH WOODEN LIPPING. THE LIPPING CAN BE OF WIDTH VARY FROM 12MM TO 25 MM AS/REQUIREMENT.

NOTE- THE COUNTER TOP FOR THE TOILET WILL BE MADE OF LIGHT SHADED GRANITE

NOTE -Use pvc corner profile above dado finish where height of dado finish is below 2250 mm

NOTE : Contractor need to provide trap doors in case of plain calcium silicate/ gypsum board false ceiling where ever required(as/mep).

NOTE : IN CASE OF UNDULATION IN WALL ALINGMENT METAL CLAMPS/HANGERS CAN BE USED FOR MDF BOARD

NOTE : AT GROUND FLOOR WHERE EVER VINYL FLOORING IS USED IN FLOORING WATERPROFFING IS NECESSARY.

FACADE FINISHES SCHEDULE		
TYPE	FINISHES MATERIAL (AS/SPEC)	
CLADDING		
1	TYPE -1 CLADDING	LARGE FORMATTED TILE - 6MM
2	TYPE -2 CLADDING	LARGE FORMATTED TILE - 6MM
LOUVERS		
1	TYPE -1	Mild Steel VERTICAL RECTANGULAR SECTIONS (AS PER DRAWING)
2	TYPE -2	ALUMINUM RECTANGULAR SECTIONS LOUVERS. (AS PER DRAWING)
3	TYPE -3	ALUMINUM Z-SHAPE LOUVERS (AS PER DRAWING)
4	TYPE -4	ALUMINUM LOUVERS INFRONT OF GLASS AT PODIUM LEVEL (AS PER DRAWING)
GLASS		
1	TYPE -1	DOUBLE GLAZED UNIT (DGU)
2	TYPE -2	SINGLE GLAZED UNIT-SPANDREL (SGU)
LAMINATED GLASS		
1	TYPE -1	TINTED GLASS FINS(OPD)
2	TYPE -2	LAMINATED GLASS FINS
PORTAL AT TERRACE		
1	TYPE -1	ACP
PORCH		
1	TYPE -1	EXT. GRADE GYPSUM PLASTER (SOFFIT) AND ACP

FINISHING SCHEDULE FOR RESIDENTIAL BLOCK

2-BHK RESIDENTIAL BLOCK

2-BHK RESIDENTIAL BLOCK		
S.no	Space/Location	Description
a.	ENTRANCE LOBBY	
	FLOORS	GRANITE STONE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN GRANITE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.	ROOMS	
b.1	MEETING ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.2	MASTER BED ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.3	BEDROOM	
	FLOORS	VITRIFIED TILE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.4	LIVING/DINING	
	FLOORS	VITRIFIED TILE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.5	SHOP	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL

c.	KITCHEN	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	COUNTER TOP	GRANITE WITH NOSING & 600MM HIGH CERAMIC TILE DADO ABOVE COUNTER TOP
	SINK	STAINLESS STEEL SINK
	FIXTURE & FITTINGS	AS PER SPECIFICATION
d.	COMMON TOILET	
	FLOORS	CERAMIC TILES
	CEILING	CALCIUM SILICATE GRID CEILING + OIL BOUND DISTEMPER
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	LEDGE WALL	GRANITE TOP
	WALLS	CERAMIC TILES UPTO LINTEL AND OIL BOUND DISTEMPER UPTO FALSE CEILING & ABOVE FALSE CEILING
e.	TOILET	
	FLOORS	CERAMIC TILES
	CEILING	CALCIUM SILICATE GRID CEILING + OIL BOUND DISTEMPER
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	LEDGE WALL	GRANITE TOP
	WALLS	CERAMIC TILES UPTO LINTEL AND OIL BOUND DISTEMPER UPTO FALSE CEILING & ABOVE FALSE CEILING
f.	ELECTRICAL ROOM	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA STONE - OIL BOUND DISTEMPER
g.	DOORS & WINDOW	
	INTERNAL	FLUSH DOOR
	DOOR FRAME	ALUMINIUM WITH WOODEN INFILL
	EXTERNAL	ALUMINIUM DOOR / WINDOW WITH WOODEN TEXTURE
	MAIN DOOR	ALUMINIUM WITH WOODEN INFILL FLUSH DOOR + WITH SS JAALI DOOR
h.	BALCONIES	
	FLOORS	OUTDOOR CERAMIC TILE ANTI SKID 300X300
	CEILING	OIL BOUND DISTEMPER
	RAILINGS	M.S. RAILING WITH POWDER COATED WITH GLASS PANEL
	WALLS	TEXTURE PAINT
i.	STAIRCASES	
	FLOORS	KOTA STONE

	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN GRANITE - OIL BOUND DISTEMPER
	RAILINGS	M.S HAND RAIL WITH POWDER COATED AS/DESIGN
j.	STAIRCASES FIRE TOWER	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA - OIL BOUND DISTEMPER
	RAILINGS	M.S HAND RAIL WITH POWDER COATED AS/DESIGN
k.	LIFT LOBBY	
	FLOORS	GRANITE STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	2450 MM DADO IN GRANITE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
l.	CORRIDOR	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	RAILINGS	M.S RAILING WITH POWDER COATED AS/DESIGN
m.	TERRACE	
	FLOORS	BROKEN CHINA CERAMIC TILES
	WALLS	HIGH QUALITY TEXTURE PAINT
n.	EXTERNAL WALLS	TEXTURE PAINT
o.	EXTERNAL JALI	WPC LOUVER
	MAIN DOOR	FLUSH DOOR WITH FLY PROOF DOOR
	FRAME	ALUMINIUM WITH WOODEN INFILL

3-BHK RESIDENTIAL BLOCK

3-BHK RESIDENTIAL BLOCK		
S.no	Space/Location	Description
a.	ENTRANCE LOBBY	
	FLOORS	GRANITE STONE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN GRANITE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.	ROOMS	
b.1	MEETING ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.2	MASTER BED ROOM	
	FLOORS	VITRIFIED TILES
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.3	BEDROOM	
	FLOORS	VITRIFIED TILE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.4	LIVING/DINING	
	FLOORS	VITRIFIED TILE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.5	SHOP	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL

c.	KITCHEN	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	COUNTER TOP	GRANITE WITH NOSING & 600MM HIGH CERAMIC TILE DADO ABOVE COUNTER TOP
	SINK	STAINLESS STEEL SINK
	FIXTURE & FITTINGS	AS PER SPECIFICATION
d.	COMMON TOILET	
	FLOORS	CERAMIC TILES
	CEILING	CALCIUM SILICATE GRID CEILING + OIL BOUND DISTEMPER
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	LEDGE WALL	GRANITE TOP
	WALLS	CERAMIC TILES UPTO LINTEL AND OIL BOUND DISTEMPER UPTO FALSE CEILING & ABOVE FALSE CEILING
e.	TOILET	
	FLOORS	CERAMIC TILES
	CEILING	CALCIUM SILICATE GRID CEILING + OIL BOUND DISTEMPER
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	LEDGE WALL	GRANITE TOP
	WALLS	CERAMIC TILES UPTO LINTEL AND OIL BOUND DISTEMPER UPTO FALSE CEILING & ABOVE FALSE CEILING
f.	ELECTRICAL ROOM	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA STONE - OIL BOUND DISTEMPER
g.	DOORS & WINDOW	
	INTERNAL	FLUSH DOOR
	DOOR FRAME	ALUMINIUM WITH WOODEN INFILL
	EXTERNAL	ALUMINIUM DOOR / WINDOW WITH WOODEN TEXTURE
	MAIN DOOR	ALUMINIUM WITH WOODEN INFILL FLUSH DOOR + WITH SS JAALI DOOR
h.	BALCONIES	
	FLOORS	OUTDOOR CERAMIC TILE ANTI SKID 300X300
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	RAILINGS	M.S. RAILING WITH POWDER COATED WITH GLASS PANEL
	WALLS	TEXTURE PAINT
i.	STAIRCASES	

	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA - OIL BOUND DISTEMPER
	RAILINGS	M.S HAND RAIL WITH POWDER COATED AS/DESIGN
j.	STAIRCASES FIRE TOWER	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA - OIL BOUND DISTEMPER
	RAILINGS	M.S HAND RAIL WITH POWDER COATED AS/DESIGN
k.	LIFT LOBBY	
	FLOORS	GRANITE STONE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	2450 MM DADO IN GRANITE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
l.	CORRIDOR	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN VITRIFIED - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	RAILINGS	M.S RAILING WITH POWDER COATED AS/DESIGN
m.	TERRACE	
	FLOORS	BROKEN CHINA CERAMIC TILES
	WALLS	HIGH QUALITY TEXTURE PAINT
n.	EXTERNAL WALLS	TEXTURE PAINT
o.	EXTERNAL JALI	WPC LOUVER

NURSE HOSTEL RESIDENTIAL BLOCK

S.no	Space/Location	Description
a.	ENTRANCE LOBBY	
	FLOORS	GRANITE STONE
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	1200 MM DADO IN GRANITE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.	ROOMS	
b.1	WARDEN ROOM & OFFICE	
	FLOORS	VITRIFIED TILE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.2	VISITOR ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.3	READING ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.4	DORMITORY	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.5	SHOP	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL

b.6	TWIN SHARING ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.7	STORE	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA STONE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
c.	KITCHEN	
	FLOORS	KOTA STONE FLOORING
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	1200 MM DADO IN KOTA STONE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL ABOVE
	COUNTER TOP	AS PER SPECIFICATION
	SINK	STAINLESS STEEL SINK
	FIXTURE & FITTINGS	AS PER SPECIFICATION
d.	DINING	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	1200 MM DADO IN VITRIFIED TILES - OIL BOUND DISTAMPER ABOVE
e.	WASHING AREA	
	FLOORS	KOTA STONE
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	1200 MM DADO IN KOTA STONE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	COUNTER TOP	AS PER SPECIFICATION
	SINK	STAINLESS STEEL SINK
	FIXTURE & FITTINGS	AS PER SPECIFICATION
f.	COMMON TOILET	
	FLOORS	CERAMIC TILES
	CEILING	CALCIUM SILICATE GRID CEILING + OIL BOUND DISTEMPER / BISON BOARD CEILING
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	LEDGE WALL	GRANITE TOP
	WALLS	CERAMIC TILE UPTO LINTEL AND OIL BOUND DISTEMPER UPTO FALSE CEILING & ABOVE FALSE CEILING

g.	WARDEN TOILET	
	FLOORS	CERAMIC TILES
	CEILING	CALCIUM SILICATE GRID CEILING + OIL BOUND DISTEMPER
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	LEDGE WALL	GRANITE TOP
	WALLS	CERAMIC TILES UPTO LINTEL AND OIL BOUND DISTEMPER UPTO FALSE CEILING & ABOVE FALSE CEILING
h.	TOILET BLOCK	
	FLOORS	CERAMIC TILES
	CEILING	CALCIUM SILICATE GRID CEILING + OIL BOUND DISTEMPER
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	LEDGE WALL	GRANITE TOP
	WALLS	CERAMIC TILES UPTO LINTEL AND OIL BOUND DISTEMPER UPTO FALSE CEILING & ABOVE FALSE CEILING
i.	ELECTRICAL ROOM	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA STONE - OIL BOUND DISTEMPER
j.	DOORS & WINDOW	
	INTERNAL	FLUSH DOOR
	DOOR FRAME	ALUMINIUM WITH WOODEN INFILL
	EXTERNAL	ALUMINIUM DOOR / WINDOW WITH WOODEN TEXTURE
k.	BALCONIES	
	FLOORS	OUTDOOR CERAMIC TILE ANTI SKID 300X300
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	RAILINGS	M.S RAILING WITH POWDER COATED AS/DESIGN
	WALLS	TEXTURE PAINT
l.	STAIRCASES	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA STONE - OIL BOUND DISTEMPER
	RAILINGS	M.S HAND RAIL WITH POWDER COATED AS/DESIGN
m.	LIFT LOBBY	
	FLOORS	GRANITE STONE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	2450 MM DADO IN GRANITE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL

n.	CORRIDOR	
	FLOORS	VITRIFIED TILE
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	WALLS	150 MM SKIRTING IN VITRIFIED TILE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	RAILINGS	M.S RAILING WITH POWDER COATED AS/DESIGN
o.	TERRACE	
	FLOORS	BROKEN CHINA CERAMIC TILES
	WALLS	HIGH QUALITY TEXTURE PAINT
p.	EXTERNAL WALLS	TEXTURE PAINT
q.	EXTERNAL JALI	WPC LOUVER

GUEST HOSTEL RESIDENTIAL BLOCK

S.no	Space/Location	Description
a.	ENTRANCE LOBBY + WAITING	
	FLOORS	GRANITE STONE
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	HPL & GRANITE DADO UPTO LINTEL LEVEL - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.	ROOMS	
b.1	MEETING ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING MATCH WITH FLOORING - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.1	GUEST ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING MATCH WITH FLOORING - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.3	TECH STAFF	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL

b.3	INTERNATIONAL GUEST ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.2	UNMARRIED RESIDENT ROOM	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.3	MARRIED RESIDENT BEDROOM	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.3	BEDROOM	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.3	LIVING/ DINING	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
b.5	STORE	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA STONE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL

c.	MAIN KITCHEN	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	COUNTER TOP	AS PER SPECIFICATION
	SINK	STAINLESS STEEL SINK
	FIXTURE & FITTINGS	AS PER SPECIFICATION
c.	KITCHEN (1 BHK)	
	FLOORS	VITRIFIED TILE ANTISKID
	CEILING	CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILES - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	COUNTER TOP	AS PER SPECIFICATION
	SINK	STAINLESS STEEL SINK
	FIXTURE & FITTINGS	AS PER SPECIFICATION
d.	DINING	
	FLOORS	VITRIFIED TILES
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	1200 MM DADO IN VITRIFIED TILES - OIL BOUND DISTAMPER ABOVE
e.	WASHING AREA	
	FLOORS	KOTA STONE
	CEILING	CALCIUM SILICATE
	WALLS	150 MM SKIRTING IN KOTA - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	COUNTER TOP	AS PER SPECIFICATION
	SINK	STAINLESS STEEL SINK
	FIXTURE & FITTINGS	AS PER SPECIFICATION
f.	TOILET + HANDWASH	
	FLOORS	CERAMIC TILES
	CEILING	CALCIUM SILICATE GRID CEILING+ OIL BOUND DISTEMPER
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	LEDGE WALL	GRANITE TOP

	WALLS	CERAMIC TILES UPTO LINTEL AND OIL BOUND DISTEMPER UPTO FALSE CEILING & ABOVE FALSE CEILING
g.	TOILET	
	FLOORS	CERAMIC TILES
	CEILING	CALCIUM SILICATE GRID CEILING + OIL BOUND DISTEMPER
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	LEDGE WALL	GRANITE TOP
	WALLS	CERAMIC TILES UPTO LINTEL AND OIL BOUND DISTEMPER UPTO FALSE CEILING & ABOVE FALSE CEILING
i.	ELECTRICAL ROOM	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	FIXTURE & FITTINGS	AS PER SPECIFICATION
	WALLS	150 MM SKIRTING IN KOTA STONE - OIL BOUND DISTEMPER
j.	DOORS & WINDOW	
	INTERNAL	FLUSH DOOR
	DOOR FRAME	ALUMINIUM WITH WOODEN INFILL
	EXTERNAL	ALUMINIUM DOOR / WINDOW WITH WOODEN TEXTURE
k.	BALCONIES	
	FLOORS	OUTDOOR CERAMIC TILE ANTI SKID 300X300
	CEILING	ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	RAILINGS	M.S RAILING WITH POWDER COATED AS/DESIGN
	WALLS	TEXTURE PAINT
l.	STAIRCASES	
	FLOORS	KOTA STONE
	CEILING	OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN KOTA STONE - OIL BOUND DISTEMPER
	RAILINGS	M.S HAND RAIL WITH POWDER COATED AS/DESIGN
m.	LIFT LOBBY	
	FLOORS	GRANITE STONE
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	2450 MM DADO IN GRANITE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	RAILINGS	M.S RAILING WITH POWDER COATED AS/DESIGN

n.	CORRIDOR	
	FLOORS	VITRIFIED TILE
	CEILING	CALCIUM SILICATE GRID CEILING + CALCIUM SILICATE BAND + OIL BOUND DISTEMPER
	WALLS	150 MM SKIRTING IN VITRIFIED TILE - ACRYLIC EMULSION PAINT WASHABLE/ ANTIBACTERIAL
	RAILINGS	M.S RAILING WITH POWDER COATED AS/DESIGN
o.	TERRACE	
	FLOORS	BROKEN CHINA CERAMIC TILES
	WALLS	HIGH QUALITY TEXTURE PAINT
p.	EXTERNAL WALLS	TEXTURE PAINT
q.	EXTERNAL JALI	WPC LOUVER

**FINISHING SCHEDULE FOR RESEARCH &
DEVELOPMENT BLOCK**

RESEARCH & DEVELOPMENT BLOCK							
S.N	LOCATION	FLOORING	SKIRTING	WALL	CEILING	COUNTER	RAILING
GROUND FLOOR							
1	DOUBLE HEIGHT ENTRANCE LOOBY	F1- GRANITE+ GRANITE INLAY	S1-GRANITE UPTO (1200MM)	W1- GRANITE+ HIGH PRESSURE LAMINATE + ACRYLIC EMULSION PAINT	C9- BAFFLE CEILING	CT2- ACRYLIC SOLID SURFACE COUNTER FOR RECEPTION AREAS AS/ DESIGN	
2	ELECTRICAL & ELECTRONIC CHARACTERIZATION LAB	F2- VITRIFIED TILE +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACCRYLIC EMULSION PAINT	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
3	MICROSCOPY LAB	F2- VITRIFIED TILE +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACCRYLIC EMULSION PAINT	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
4	FACULTY ROOM	F3- VITRIFIED TILE (2'X2')	S2+S3- 150MM SKIRTING SAME AS FLOORING + FULL HEIGHT PRELAMINATED WOODEN PANELLING ON ONE WALL	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		
5	OPEN STILT	F3- VITRIFIED TILE (2'X2')	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACRYLIC EMULSION PAINT	C8- MOISTURE RESISTANT GYPSUM		
6	PANTRY	F5- VITRIFIED TILE ANTI SKID	S4- CERAMIC TILE UPTO LINTEL LEVEL	W3- ACRYLIC EMULSION PAINT	C8- MOISTURE RESISTANT GYPSUM	CT1- GRANITE TOP	
7	OPEN CAFÉ(STILT)	F3- VITRIFIED TILE (2'X2')	S2- VITRIFIED TILE UPTO (1200MM)	-	C9- BAFFLE CEILING		

FIRST FLOOR							
1	ADVANCE ELECTRONICS LAB	F2- VITRIFIED TILE +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACRYLIC EMULSION PAINT	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
2	MECHANICAL CHARACTERIZATION LAB	F2- VITRIFIED TILE +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACRYLIC EMULSION PAINT	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
3	TESTING LAB	F2- VITRIFIED TILE +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACRYLIC EMULSION PAINT	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
4	MATERIAL CHARACTERIZATION LAB	F2- VITRIFIED TILE +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACRYLIC EMULSION PAINT	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
5	FACULTY ROOM	F3- VITRIFIED TILE (2'X2')	S2+S3- 150MM SKIRTING SAME AS FLOORING + FULL HEIGHT PRELAMINATED WOODEN PANELLING ON ONE WALL	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		
6	HOD ROOM	F10- LAMINATED WOODEN FLOORING	S2+S3- 150MM SKIRTING SAME AS FLOORING + FULL HEIGHT PRELAMINATED WOODEN PANELLING ON ONE WALL	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		
7	MEETING ROOM (AS/DRGS)	F9- LAMINATED WOODEN FLOORING	150MM SKIRTING SAME AS FLOORING	W7- COMBINATI ON OF HIGH PRESSURE LAMINATE PANELING TILL 900MM & ABOVE ACOUSTIC WALL	C4- FULLY PERFORATED GYPSUM BOARD + 0.9 NRC TILE		

				PANELLING TILL DOOR HEIGHT			
8	OFFICE	F3- VITRIFIED TILE (2'X2')	S2+S3- 150MM SKIRTING SAME AS FLOORING + FULL HEIGHT PRELAMINATED WOODEN PANELLING ON ONE WALL	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		
9	LIBRARY	F3- VITRIFIED TILE (2'X2')	S2- 150MM SKIRTING SAME AS FLOORING	W3- ACRYLIC EMULSION PAINT	C6- DECORATIVE MODULAR ACOUSTIC PANEL +GYPSUM BOARD		
10	LECTURE HALL	F10- LAMINATED WOODEN FLOORING	150MM SKIRTING SAME AS FLOORING	W4- ENGINEERE D ACOUSTIC WOODEN PANELLING + ACRYLIC EMULSION PAINT ABOVE	C4+C9- FULLY PERFORATED GYPSUM BOARD + 0.9 NRC TILE + BAFFLE CEILING SLATS		
11	PANTRY	F5- VITRIFIED TILE ANTI SKID	S4- CERAMIC TILE UPTO LINTEL LEVEL	W3- ACRYLIC EMULSION PAINT	C8- MOISTURE RESISTANT GYPSUM	CT1- GRANITE TOP	
SECOND FLOOR							
1	CLASS ROOM	F3- VITRIFIED TILE (2'X2')	S2- 1200 MM DADO SAME AS FLOORING	W3- ACRYLIC EMULSION PAINT	C4- FULLY PERFORATED GYPSUM BOARD + 0.9 NRC TILE		
2	60 SEATER LECTURE HALL	F3- VITRIFIED TILE (2'X2')	S2- 1200 MM DADO SAME AS FLOORING	W3- ACRYLIC EMULSION PAINT	C4- FULLY PERFORATED GYPSUM BOARD + 0.9 NRC TILE		
3	INCUBATOR BIONEST	F3- VITRIFIED TILE (2'X2')	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		
4	COMPUTATIONA L LAB (RESEARCH SCHOLORS)	F3- VITRIFIED TILE (2'X2')	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID		

					CEILING		
5	FACULTY ROOM	F3- VITRIFIED TILE (2'X2')	S2+S3- 150MM SKIRTING SAME AS FLOORING + FULL HEIGHT PRELAMINATED WOODEN PANELLING ON ONE WALL	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		
6	DESIGN LAB	F2- VITRIFIED TILE ANTI-ACID +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W2- ACCRYLIC EMULSION PAINT (ANTI BACTERIAL)	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
7	BOARD ROOM (AS/DRGS)	F9- LAMINATED WOODEN FLOORING	150MM SKIRTING SAME AS FLOORING	W7- COMBINATI ON OF HIGH PRESSURE LAMINATE PANELING TILL 900MM & ABOVE ACOUSTIC WALL PANELLING TILL DOOR HEIGHT	C4- FULLY PERFORATED GYPSUM BOARD + 0.9 NRC TILE		
THIRD FLOOR							
1	LECTURE HALL	F3- VITRIFIED TILE (2'X2')	S2- 1200 MM DADO SAME AS FLOORING	W4- ENGINEERE D ACOUSTIC WOODEN PANELLING + ACRYLIC EMULSION PAINT ABOVE	C4- FULLY PERFORATED GYPSUM BOARD + 0.9 NRC TILE		
2	SUPPORT ROOM	F6- POLISHED KOTA	S6- 150MM SKIRTING SAME AS FLOORING	W2- ACCRYLIC EMULSION PAINT (ANTI BACTERIAL)	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING		
3	SIMULATION LAB 1	F2- VITRIFIED TILE ANTI-ACID +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W2- ACCRYLIC EMULSION PAINT (ANTI BACTERIAL)	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	

4	SIMULATION LAB 2	F2- VITRIFIED TILE ANTI-ACID +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W2- ACCRYLIC EMULSION PAINT (ANTI BACTERIAL)	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
5	CONTROL ROOM	F6- POLISHED KOTA	S5- 150MM SKIRTING SAME AS FLOORING	W6-OIL BOUND DISTEMPER	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		
6	MULTIPURPOSE PROCEDURAL ROOM	F2- VITRIFIED TILE ANTI-ACID +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W2- ACCRYLIC EMULSION PAINT (ANTI BACTERIAL)	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
7	DEEP BRIEFING	F3- VITRIFIED TILE (2'X2')	S2- 1200 MM DADO SAME AS FLOORING	W3- ACRYLIC EMULSION PAINT	C4- FULLY PERFORATED GYPSUM BOARD + 0.9 NRC TILE		
8	CONSULTATION ROOM	F3- VITRIFIED TILE (2'X2')	S2+S3- 150MM SKIRTING SAME AS FLOORING + FULL HEIGHT PRELAMINATED WOODEN PANELLING ON ONE WALL	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		
9	MULTIPURPOSE CLASSROOM	F3- VITRIFIED TILE (2'X2')	S2- 1200 MM DADO SAME AS FLOORING	W3- ACRYLIC EMULSION PAINT	C4- FULLY PERFORATED GYPSUM BOARD + 0.9 NRC TILE		
10	OFFICE	F3- VITRIFIED TILE (2'X2')	S2+S3- 150MM SKIRTING SAME AS FLOORING + FULL HEIGHT PRELAMINATED WOODEN PANELLING ON ONE WALL	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		
11	ROOM	F6- POLISHED KOTA	S6- 150MM SKIRTING SAME AS FLOORING	W6-OIL BOUND DISTEMPER	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		

FOURTH FLOOR

1	CLASS ROOM	F3- VITRIFIED TILE (2'X2')	S2- 1200 MM DADO SAME AS FLOORING	W3- ACRYLIC EMULSION PAINT	C4- FULLY PERFORATED GYPSUM BOARD + 0.9 NRC TILE		
2	OPEN LAB	F2- VITRIFIED TILE +HEAVY DUTY VITRIFIED TILE	S2- VITRIFIED TILE UPTO (1200MM)	W3- ACRYLIC EMULSION PAINT	C2-FULLY PERFORATED GYPSUM BOARD CEILING / METAL CEILING	CT1- GRANITE TOP	
3	FACULTY ROOM	F3- VITRIFIED TILE (2'X2')	S2+S3- 150MM SKIRTING SAME AS FLOORING + FULL HEIGHT PRELAMINATED WOODEN PANELLING ON ONE WALL	W3- ACRYLIC EMULSION PAINT	C3- GYPSUM BOARD + MINIRAL FIBRE GRID CEILING		

TYPICAL AREA

1	STAIRCASE - 01 & 02	F6- POLISHED KOTA	S6- 150MM SKIRTING SAME AS FLOORING	W3- ACRYLIC EMULSION PAINT	C7- ACRYLIC EMULSION PAINT		<p>ALL PROVISION OF UNIVERSAL ACCESSIBILITY INCLUDING TACTILE SURFACES AND RAILING DESIGN TO BE AS PER RELEVANT CODE.</p> <p>SS GRADE 304 RAILING ON ONE SIDE AND HAND RAIL ON OTHER SIDE WITH SS GRADE 304 HAND RAIL 65 MM DIA</p>
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2	STAIRCASE - 03	F4- GRANITE FLOORING	S1- 150MM SKIRTING SAME AS FLOORING	-	C7- ACRYLIC EMULSION PAINT		SS GRADE 304 RAILING ON BOTH SIDE WITH SS GRADE 304 HAND RAIL 65 MM DIA
3	TERRACE	F8- CERAMIC TILE		-	-		
4	BALCONY	F5- VITRIFIED TILE ANTI SKID					
5	LIFT LOBBY (AS/DRGS)	F4- GRANITE FLOORING	S1- 150MM SKIRTING SAME AS FLOORING	W5- GRANITE+ PRELAMINATED WOOD PANELLING	C5- GYPSUM BOARD + WOODEN GRID TILE CEILING + MINIRAL FIBRE GRID CEILING +0.7 NRC ACOUSTIC TILE		
6	AHU ROOM	F7- ROUGH KOTA	S5- 150MM SKIRTING SAME AS FLOORING	W6-OIL BOUND DISTEMPER	C1- OIL BOUND DISTEMPER		
7	CORRIDOR	F3- VITRIFIED TILE (2'X2')	S2- 1200 MM DADO SAME AS FLOORING	W3- ACRYLIC EMULSION PAINT	C10- GYPSUM BOARD +0.7 NRC ACOUSTIC TILE		
8	STUDENT TOILET	F5- VITRIFIED TILE ANTI SKID	S4- CERAMIC TILE UPTO LINTEL LEVEL	W3- ACRYLIC EMULSION PAINT	C8- MOISTURE RESISTANT GYPSUM	CT2- ACRYLIC SOLID SURFACE	
9	STAFF TOILET	F5- VITRIFIED TILE ANTI SKID	S4- CERAMIC TILE UPTO LINTEL LEVEL	W3- ACRYLIC EMULSION PAINT	C8- MOISTURE RESISTANT GYPSUM	CT2- ACRYLIC SOLID SURFACE COUNTER	
10	STORE	F7- ROUGH KOTA	S5- 150MM SKIRTING SAME AS FLOORING	W6-OIL BOUND DISTEMPER	C1- OIL BOUND DISTEMPER		
11	ELECTRICAL ROOM	F7- ROUGH KOTA	S5- 150MM SKIRTING SAME AS FLOORING	W6-OIL BOUND DISTEMPER	C1- OIL BOUND DISTEMPER		
12	UPS ROOM	F7- ROUGH KOTA	S5- 150MM SKIRTING SAME AS FLOORING	W6-OIL BOUND DISTEMPER	C1- OIL BOUND DISTEMPER		
13	FIRE COMMAND ROOM	F7- ROUGH KOTA	S5- 150MM SKIRTING SAME AS FLOORING	W6-OIL BOUND DISTEMPER	C1- OIL BOUND DISTEMPER		

14	CONNECTION BRIDGE	F4- GRANITE FLOORING	S1- 150MM SKIRTING SAME AS FLOORING	-	C8- MOISTURE RESISTANT GYPSUM		SS GRADE 304 RAILING ON BOTH SIDE WITH SS GRADE 304 HAND RAIL 65 MM DIA
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FINISHING SCHEDULE FOR MISCELLANEOUS AREA

FINISHING SCHEDULE (MISCELLANEOUS AREAS)					
SERVICE BLOCK					
S. NO.	ROOM DETAILS	Floor	Skirting	Wall	Ceiling
1	SERVICE AREAS LIKE ESS , CHILLER PLANT , PUMP ROOM	ROUGH KOTA	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	DISTEMPER PAINT	DISTEMPER PAINT
2	STAIRCASE	POLISH KOTA	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	DISTEMPER PAINT	DISTEMPER PAINT
3	TERRACE	ROUGH KOTA	150 MM VITRIFIED TILES ALIGNED WITH FLOORING	DISTEMPER PAINT	.....
4	TOILET	300 X300 MM CERAMIC TILES	150 MM VITRIFIED TILES ALIGNED WITH FLOORING	300 X300 MM CERAMIC TILES	DISTEMPER PAINT
5	OFFICE	600 x 600 MM VITRIFIED TILES	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	DISTEMPER PAINT	600X600 MM MFT(MINERAL FIBRE) CEILING WITH CALCIUM SILICATE BOARD.
GUARD ROOM					
6	GUARD ROOM	600 x 600 MM VITRIFIED TILES	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	DISTEMPER PAINT	.....
7	TOILET	300 X300 MM CERAMIC TILES	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	300 X300 MM CERAMIC TILES	DISTEMPER PAINT
8	SERVICE ROOM	ROUGH KOTA	150MM HIGH SKIRTING OF SAME MATERIAL OF FLOORING	DISTEMPER PAINT	DISTEMPER PAINT

PART-E - SCHEDULE OF STAGE PAYMENTS

PART-E				
		Name of Work: Construction of a Centre of Excellence in Healthcare R & D Facility - Includes Super-Specialty Hospital, PG Medical & Allied Education and Ancillary Facilities at IIT Guwahati campus of Assam Government-IITG Healthcare Foundation (AGIHF) on EPC Mode-III.		
		<u>Schedule of Stage Payments</u>		
		All running / intermediate & final payments shall be made to the agency in accordance with the following schedule:		
H.NO	S.HNO	On completion of stage	Individual %age	Cumulative %age
1	1	Completion of Super Specialty (SS) Hospital Building in all respects as per scope of work (95.00% of the Quoted Amount for Item No. 1.0 of Financial Quote Part H) & as per NIT		
1	1.1	Civil Works of for SS Hospital Building		
1	1.1	Completion of RCC work & structural steel work		
1	1.1	RCC work		
1	1.1.1	Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 25% of total no.	1.600%	1.600%
1	1.1.2	Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 50% of total no.	1.600%	3.200%
1	1.1.3	Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 75% of total no.	1.600%	4.800%
1	1.1.4	Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 100% of total no.	1.600%	6.400%
1	1.1.5	Testing of piles - Initial and routine and Integrity	0.090%	6.490%
1	1.1.6	Excavation, Laying lean concrete below pile caps, raft - 50% area of total area	0.130%	6.620%
1	1.1.7	Excavation, Laying lean concrete below pile caps, raft - 100% area of total area	0.130%	6.750%
1	1.1.8	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -25% Area of total	1.830%	8.580%
1	1.1.9	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -50% Area of total	1.840%	10.420%
1	1.1.10	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -75% Area of total	1.840%	12.260%
1	1.1.11	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -100% Area total	1.840%	14.100%
1	1.1.12	Casting RCC columns, shear walls, lift retaining wall upto bottom of grade slab i/c reinforcement, form work	0.650%	14.750%

1	1.1.13	Filling earth over RCC caps, raft, ground i/c compaction to 95% proctor's density - 50% of total area	0.090%	14.840%
1	1.1.14	Filling earth over RCC caps, raft, ground i/c compaction to 95% proctor's density - 100% of total area	0.090%	14.930%
1	1.1.15	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 25% area of total	0.380%	15.310%
1	1.1.16	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 50% area of total	0.380%	15.690%
1	1.1.17	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 75% area of total	0.380%	16.070%
1	1.1.18	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 100% area of total	0.380%	16.450%
1	1.1.19	Casting RCC columns, shear walls, lift walls up to Ground Floor roof slab Level - 50% area	0.530%	16.980%
1	1.1.20	Casting RCC columns, shear walls, lift walls up to Ground Floor roof slab Level - 100% area	0.530%	17.510%
1	1.1.21	Casting of RCC staircase, beam and slab of Ground floor roof - 50% area	1.187%	18.697%
1	1.1.22	Casting of RCC staircase, beam and slab of Ground floor roof - 100% area	1.187%	19.884%
1	1.1.23	Casting RCC columns, shear walls, lift walls up to First Floor roof slab Level - 50% area	0.517%	20.401%
1	1.1.24	Casting RCC columns, shear walls, lift walls up to First Floor roof slab Level - 100% area	0.517%	20.918%
1	1.1.25	Casting of RCC staircase, beam and slab of First floor roof - 50% area	1.092%	22.010%
1	1.1.26	Casting of RCC staircase, beam and slab of First floor roof - 100% area	1.092%	23.102%
1	1.1.27	Casting RCC columns, shear walls, lift walls up to Second Floor roof slab Level - 50% area	0.516%	23.618%
1	1.1.28	Casting RCC columns, shear walls, lift walls up to Second Floor roof slab Level - 100% area	0.516%	24.134%
1	1.1.29	Casting of RCC staircase, beam and slab of Second floor roof - 50% area	1.092%	25.226%
1	1.1.30	Casting of RCC staircase, beam and slab of second floor roof - 100% area	1.092%	26.318%
1	1.1.31	Casting RCC columns, shear walls, lift walls up to Third Floor roof slab Level - 50% area	0.415%	26.733%
1	1.1.32	Casting RCC columns, shear walls, lift walls up to Third Floor roof slab Level - 100% area	0.415%	27.148%
1	1.1.33	Casting of RCC staircase, beam and slab of Third floor roof - 50% area	1.100%	28.248%
1	1.1.34	Casting of RCC staircase, beam and slab of Third floor roof - 100% area	1.100%	29.348%
1	1.1.35	Casting RCC columns, shear walls, lift walls up to Fourth Floor roof slab Level - 50% area	0.414%	29.762%
1	1.1.36	Casting RCC columns, shear walls, lift walls up to Fourth Floor roof slab Level - 100% area	0.414%	30.176%
1	1.1.37	Casting of RCC staircase, beam and slab of Fourth floor roof - 50% area	1.100%	31.276%

1	1.1.38	Casting of RCC staircase, beam and slab of Fourth floor roof - 100% area	1.100%	32.376%
1	1.1.39	Casting RCC columns, shear walls, lift walls up to Fifth Floor roof slab Level - 50% area	0.414%	32.790%
1	1.1.40	Casting RCC columns, shear walls, lift walls up to Fifth Floor roof slab Level - 100% area	0.414%	33.204%
1	1.1.41	Casting of RCC staircase, beam and slab of Fifth floor roof - 50% area	1.100%	34.304%
1	1.1.42	Casting of RCC staircase, beam and slab of Fifth floor roof - 100% area	1.100%	35.404%
1	1.1.43	Casting RCC columns, shear walls, lift walls up to sixth Floor roof slab Level - 50% area	0.414%	35.818%
1	1.1.44	Casting RCC columns, shear walls, lift walls up to six Floor roof slab Level - 100% area	0.414%	36.232%
1	1.1.45	Casting of RCC staircase, beam and slab of six floor roof - 50% area	1.100%	37.332%
1	1.1.46	Casting of RCC staircase, beam and slab of sixth floor roof - 100% area	1.100%	38.432%
1	1.1.47	Casting of RCC staircase, column, beam and slab, water tank and all other RCC work at terrace floor - 100% area	0.075%	38.507%
1	1.1.48	Providing Antitermite treatment to all blocks	0.459%	38.966%
1	1.1.49	Providing and fixing aluminium profile expansion joint treatment system on roof and vertical joint	0.070%	39.036%
1	1.1.50	Providing and fixing aluminium profile expansion joint treatment system on floors	0.300%	39.336%
1	1.2	Structural steel work	0.000%	39.336%
1	1.2.1	Providing Structural steel work built up sections at terrace level i/c fabricating, erecting, primer and painting etc. complete	0.370%	39.706%
1	1.2.2	Providing steel work for various misc. works with primer and painting etc. complete at all floors.	0.344%	40.050%
1	1.3	Completion of all Masonry walls including RCC lintels, bands, mullions, stub columns with reinforcement and form work etc.	0.000%	40.050%
1	1.3.1	All Masonry works for Ground Floor Level	0.880%	40.930%
1	1.3.2	All Masonry works for First Floor Level	0.630%	41.560%
1	1.3.3	All Masonry works for second Floor Level	0.590%	42.150%
1	1.3.4	All Masonry works for third Floor Level	0.500%	42.650%
1	1.3.5	All Masonry works for fourth Floor Level	0.500%	43.150%
1	1.3.6	All Masonry works for fifth Floor Level	0.500%	43.650%
1	1.3.7	All Masonry works for sixth Floor Level	0.500%	44.150%
1	1.3.8	On completion of Masonry work up to terrace slab, Mumty, lift Machine room & terrace parapets.	0.080%	44.230%

1	1.4	Internal plaster works on ceiling, walls	0.000%	44.230%
1	1.4.1	Completion of internal plaster work up to Ground & First Floor Level	0.326%	44.556%
1	1.4.2	Completion of internal plaster work up to Second & Third Floor Level	0.216%	44.772%
1	1.4.3	Completion of internal plaster work up to Forth & Fifth Floor Level	0.185%	44.957%
1	1.4.4	Completion of internal plaster work up to Sixth Floor Level, terrace floor, Mumty, lift Machine room	0.185%	45.142%
1	1.5	External wall Finishing with Sintered porcelain large tiles / plaster from ground to parapet, Mumty top level	0.000%	45.142%
1	1.5.1	External waterproof plaster below tile cladding / mumty / parapet on walls	0.044%	45.186%
1	1.5.2	Sintered large porcelain tile cladding system - 25% area of total	0.710%	45.896%
1	1.5.3	Sintered large porcelain tile cladding system - 50% area of total	0.710%	46.606%
1	1.5.4	Sintered large porcelain tile cladding system - 75% area of total	0.710%	47.316%
1	1.5.5	Sintered large porcelain tile cladding system - 100% area of total	0.710%	48.026%
1	1.6	Completion of stone / tiles flooring, PCC floor including skirting, PCC required in sunken areas and below tile flooring to match levels at all levels	0.000%	48.026%
1	1.6.1	Lean PCC below floors in sunken areas, leveling concrete in M10 / PCC 1:3:6 over AAC Broken blocks filling	0.179%	48.205%
1	1.6.2	Prepolished Engineered Marble stone flooring and skirting	0.770%	48.975%
1	1.6.3	Cement concrete flooring in mix 1:2:4 of required thickness below vinyl	0.164%	49.139%
1	1.6.4	Polished granite minimum 18mm thick on counters, sills, ledge i/c moulding, polishing	0.050%	49.189%
1	1.6.5	Polished and anti skid vitrified tile flooring & skirting with epoxy grouting of required size / shape and thickness	1.480%	50.669%
1	1.6.6	Granite flooring in steps, s/c skirting and other areas as per drawings, at all floors including moulding, grinding and polishing.	0.455%	51.124%
1	1.6.7	Kota stone flooring minimum 25mm thick, skirting and grinding and polishing.	0.350%	51.474%
1	1.7	Completion of Waterproofing works i/c gola, plaster	0.000%	51.474%
1	1.7.1	Terraces i/c mumty roof waterproofing with brick bat coba treatment, concrete golas, khurras at all blocks	0.350%	51.824%
1	1.7.2	Waterproofing of sunken areas of toilets, kitchen, pantry, balconies etc. i/c protection plaster at all levels. Waterproofing of OH water tanks.	0.094%	51.918%
1	1.7.3	Polyurea Waterproofing minimum 2 coats of landscape terrace / open terraces at lower floors i/c grading with concrete in slope, insulation	0.273%	52.191%

1	1.8	Completion of aluminium rough sub frame, powder coated extruded aluminium profile door frames	0.000%	52.191%
1	1.8.1	Natural aluminium rectangular tube subframe for doors, windows, ventilators, glazing's	0.100%	52.291%
1	1.8.2	Powder coated aluminium extruded profile size section 100mm x 55mm x 2mm thick fixed with fasteners	0.245%	52.536%
1	1.9	Completion of all ceramic & vitrified tile dado, granite dado, including window sills and jambs etc.	0.000%	52.536%
1	1.9.1	Vitrified /ceramic tile dado in toilets, kitchen, pantry at all floors	0.234%	52.770%
1	1.9.2	Polished granite / engineered marble dado, bands, in lift lobbies, corridors etc. at all floors	0.544%	53.314%
1	1.10	On Completion of external Curtain glazing / Structural Glazing with DGU's, spandrel panel, insulation, Aluminum Panels, , etc.	0.000%	53.314%
1	1.10.1	Supplying, fabricating, installing polyester powder coated curtain wall / structural glazing system on external façade as per elevations	1.432%	54.746%
1	1.10.2	Supplying, fabricating and installing powder coated windows / ventilator shutters with SS stays, openable shutters in CW glazing	0.160%	54.906%
1	1.10.3	Providing, assembling and supplying vision glass panels (IGUs) comprising of hermetically-sealed 6-12- 6 mm insulated glass (double glazed) vision panel units -Coloured tinted float glass 6mm thick substrate with reflective soft coating on face # 2, + 12mm Airgap + 6mm Heat Strengthened clear Glass - SKN including testing of system for wind pressure, water infiltration.	0.605%	55.511%
1	1.10.4	Supply & installation of suspended Spider Glazing system including toughened glass with SS 316 grade spider fittings complete	0.560%	56.071%
1	1.10.5	Providing and supplying Spandrel Glass Panels comprising of 6 mm thick heat strengthened monolithic float glass of approved colour and shade with reflective soft coating on surface # 2, shadow box complete	0.224%	56.295%
1	1.11	On completion of False ceiling works complete	0.000%	56.295%
1	1.11.1	Providing Mineral fibre tiles false ceiling tiles of minimum size 595X595mm of approved texture, design and pattern of all NRC's with approved grid at all floors	1.340%	57.635%
1	1.11.2	Providing and fixing wooden finish U Baffle Aluminium panel ceiling as approved at all floors	0.278%	57.913%
1	1.11.3	GI Metal false Ceiling Lay in perforated Tegular edge global white color tiles of size 595x595 mm and 0.5 mm thick with 8 mm drop with grid at all floors	0.550%	58.463%
1	1.11.4	12.5 mm thick tapered edge gypsum plain board / MR grade i/c frame work at all floors i/c making coves, providing trap doors	0.290%	58.753%
1	1.11.5	Providing calcium silicate board ceiling with GI frame work i/c bulk heads for grid ceiling, trap doors	0.540%	59.293%
1	1.12	On Completion of external louvers, WCP jalli / screens, ACP sheet cladding work complete	0.000%	59.293%

1	1.12.1	Supply and installation of Z shape louvers polyester powder coated minimum 60 micron fixed with anchor fasteners at all levels.	0.155%	59.448%
1	1.12.2	Supply and installation of mild steel frame work for aluminium louvers, WPC screens, ACP Cladding on portal etc. i/c primer and anti rust painting.	0.560%	60.008%
1	1.12.3	Supply and installation of aluminium composite panel cladding on portal, other elements as per elevations, drawings at all levels.	0.660%	60.668%
1	1.12.4	Supply and installation of wood composite panels / screens / jalis as per elevations, drawings at all levels.	0.100%	60.768%
1	1.13	On completion of internal / external white cement based putty, anti bacterial plastic emulsion painting, oil bound distempering, white washing, enamel painting and finishing work	0.000%	60.768%
1	1.13.1	White cement based putty on ceiling and walls at all floors	0.484%	61.252%
1	1.13.2	Oil bound distemper, Synthetic enamel painting, while washing, primer on walls, ceiling, lift wells, shafts at all levels	0.063%	61.315%
1	1.13.3	Exterior grade emulsion paint with primer on exterior surfaces at terrace and parapets at all levels	0.460%	61.775%
1	1.13.4	Anti bacterial plastic emulsion paint on ceiling and walls at all floors	1.700%	63.475%
1	1.14	On completion of fire doors, shaft doors i/c hardware	0.000%	63.475%
1	1.14.1	Supply and installation of 120 minutes fire rated door frame and shutters with or without fire rated vision panel glass, SS butt hinges, sealing of joints of frame and walls	0.310%	63.785%
1	1.14.2	Supplying and fixing SS fire rated hardware for fire and shaft doors like panic bar, trim, door closers, tower bolt, coordinator	0.055%	63.840%
1	1.15	On completion of glass doors, glass paneling and mirrors etc.	0.000%	63.840%
1	1.15.1	Providing and fixing 12mm thick frameless plate glass door shutters, glass panes in windows, ventilators, fixed glazing tempered / non tempered / mirrors in toilets	0.150%	63.990%
1	1.15.2	Providing and fixing 6mm thick lacquered glass paneling on walls in lobbies	0.130%	64.120%
1	1.16	On completion of interior wall finishing with PVC vinyl sheet, acoustic panels etc.	0.000%	64.120%
1	1.16.1	Providing and fixing 1mm thick heterogeneous compact PVC (Poly Vinyl Wall Covering) for Interior wall area	0.500%	64.620%
1	1.16.2	Providing and fixing Interior wall area with acoustic wall panels, fabric panels, prelaminated board and all other finishes except PVC vinyl, painting, vitrified tile cladding	0.930%	65.550%
1	1.17	On completion of interior flooring & skirting finishing - Hospital grade PVC vinyl sheet, self leveling, laminated HDF flooring, skirting profiles	0.000%	65.550%
1	1.17.1	Providing & applying self levelling on uneven subfloor using self leveling compound below PVC vinyl sheet , laminated HDF floors	0.210%	65.760%

1	1.17.2	Providing and fixing 2 mm thick heterogeneous PVC (poly vinyl flooring) and skirting i/c making cove at all floors	1.240%	67.000%
1	1.18	On completion of stainless steel 304 grade railing, glass railings with stainless steel supports	0.000%	67.000%
1	1.18.1	Stainless steel 304 grade railings for staircases, balconies, terraces, double height areas, lobbies etc.	0.160%	67.160%
1	1.18.2	Providing and fixing 1200mm high Laminated toughened glass railing (6 mm clear glass FT + 1.52 mm pvb film + 6 mm clear glass FT) with SS 316 adaptor & SS 316 balusters	0.150%	67.310%
1	1.19	On completion of All type of door, windows, ventilators hardware	0.000%	67.310%
1	1.19.1	All hardware like stainless steel 304 grade handles, tower bolts, mortice locks, cylinders, door stoppers, door buffers, SS kick plates, push plates, mop plates, floor springs, SS sign plates, SS door handles at all floors	0.730%	68.040%
1	1.19.2	Door closers of all types at all floors	0.470%	68.510%
1	1.20	On completion of Atrium laminated glass roof	0.000%	68.510%
1	1.20.1	Supply fabricating and installation of FE 250 grade mild steel hollow section frame work for atrium glass roof including necessary bolts, removing the welding burr and preparing surface for painting with wire brush cleaning and applying two coats of epoxy red oxide zinc phosphate primer of 30 microns each and two coats of Epoxy Corrosion Resistant Enamel paint of 30 microns	0.680%	69.190%
1	1.20.2	Providing and fixing laminated glass 6mm clear +1.52 mm PVB film + 8mm clear glass roofing i/c providing aluminium strip with epdm on the joints complete for leakage proof roof.	0.430%	69.620%
1	1.21	On completion of All toilet / bath cubicles & urinal partition	0.000%	69.620%
1	1.21.1	Toilet cubicles made from 12mm thick HPL board with all accessories as per GFC drawings & HPL urinal partitions	0.380%	70.000%
1	1.22	Solar panels support structure consisting of Galvanised steel sections as per GFC	0.000%	70.000%
1	1.22.1	Providing, fabricating galvanised steel framing to support solar panels for various height at various floors i/c fixing to roof slabs with bolts.	0.410%	70.410%
1	1.23	Fixed laminated cabinets for kitchen, pantry, toilets	0.000%	70.410%
1	1.23.1	Providing fixed laminated cabinets made from MR grade commercial board and pasted with 1 mm thick laminate on all sides, lock, SS handles complete	0.105%	70.515%
1	1.24	On completion of entire work including treatment of Column guards, Roller Blinds, Curtains signage's, etc. and testing		70.515%
1	1.24.1	On completion of treatment of Column guards, signage's, Roller Blinds, Curtains etc.	0.630%	71.145%
1	1.2.	Internal Water supply, Sanitary Installation and Drainage work up to first manhole including preparation of shop drawings		71.145%

1	1.2.1	Completion of Internal grid of water supply CPVC concealed and exposed piping 20mm to 40mm dia for ground and first floor level i/c thermal insulation complete	0.142%	71.287%
1	1.2.2	Completion of Internal grid of water supply CPVC concealed and exposed piping 20mm to 40mm dia for second and third floor level i/c thermal insulation complete	0.142%	71.429%
1	1.2.3	Completion of Internal grid of water supply CPVC concealed and exposed piping 20mm to 40mm dia for fourth, fifth, sixth and terrace floor level i/c thermal insulation complete	0.142%	71.571%
1	1.2.4	Completion of exposed CPVC SCH-40 piping 50mm to 150mm dia up to Terrace Floor level and terrace water tanks	0.125%	71.696%
1	1.2.5	Completion of sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, with all necessary fittings from 40mm to 160mm dia at ground and first floor levels	0.178%	71.874%
1	1.2.6	Completion of sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, with all necessary fittings from 40mm to 160mm dia at second and third floor levels	0.178%	72.052%
1	1.2.7	Completion of sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, with all necessary fittings from 40mm to 160mm dia at fourth, fifth, sixth and terrace floor levels	0.178%	72.230%
1	1.2.8	On fixing of forged brass ball valves , butter fly valves	0.036%	72.266%
1	1.2.9	On completion of uPVC pipes 110mm / 160mm OD pipe i/c fittings complete	0.178%	72.444%
1	1.2.10	SITC of Micro Processor Controlled air cooled Heat pump delivering actual capacity, Nominal Input Power - 21.5 KW, Output Heating capacity - 70 kW complete system - 3nos.	0.142%	72.586%
1	1.2.11	SITC of SS 316 horizontal hot water storage tank with 4 mm thickness suitable for minimum 5 Kg /Sqm working pressure, 7500 litres capacity - 2no	0.178%	72.764%
1	1.2.12	On supply and fixing of white Poly propylene (PP) sink with C.I bracket, C.P. brass chain with rubber plug, 40 mm C.P. brass waste complete	0.062%	72.826%
1	1.2.13	On supply and fixing of white vitreous china wash basin with special fabricated brackets painted white, faucets as required, 32 mm C.P. brass waste.32 mm C.P. brass bottle trap & pipe to wall with rubber adopter for waste connection and C.P. brass wall flange	0.080%	72.906%
1	1.2.14	On supply and fixing urinals with fittings complete	0.044%	72.950%
1	1.2.15	Supply and fixing of water supply fittings and fixtures - CP mixer, faucet, bib cock etc. all complete	0.036%	72.986%
1	1.2.16	Supply and fixing of wall hung WC with cover - 50% of total nos.	0.053%	73.039%
1	1.2.17	Supply and fixing of wall hung WC with cover - 100% of total nos.	0.053%	73.092%
1	1.2.18	On completion of all items not mentioned above but shown in GFC drawings / required to complete work	0.036%	73.128%

1	1.2.19	On completion of entire work and testing	0.017%	73.145%
1	1.3	E & M Works of Hospital Building		73.145%
1	1.3	Internal Electrical works including MDB's, Light Fixture, fans		73.145%
1	1.3.1.1	Laying of Conduit and junction boxes for light / ceiling fan / exhaust fan points, light & power plugs for all floors in recess / surface complete	0.100%	73.245%
1	1.3.1.2	Drawing PVC insulated copper wires 1.5 sqmm in conduits for light / ceiling fan / exhaust fan points, call bell points for ground, first and second floor complete	0.100%	73.345%
1	1.3.1.3	Drawing PVC insulated copper wires 1.5 sqmm in conduits for light / ceiling fan / exhaust fan points, call bell points for third floor to terrace floor, complete	0.100%	73.445%
1	1.3.1.4	Fixing of modular switches & connections at all floors for light / ceiling fan / exhaust fan points, call bell points, complete	0.100%	73.545%
1	1.3.1.5	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 1 No. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for ground, first and second floor complete	0.343%	73.888%
1	1.3.1.6	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 1 No. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for third floor to terrace floor, complete	0.343%	74.231%
1	1.3.1.7	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for ground and first floor complete	0.756%	74.987%
1	1.3.1.8	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for second and third floor complete	0.756%	75.743%
1	1.3.1.9	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for fourth floor to terrace, complete	0.756%	76.499%
1	1.3.1.10	Wiring for circuit/ submain wiring along with earth wire with various sizes of FRLS PVC insulated copper conductor, single core cable at all floors in MS conduits	0.450%	76.949%
1	1.3.1.11	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections and 6 pin 5/6 A & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. at all floors	0.090%	77.039%

1	1.3.1.12	Supply & fixing GI RACEWAY- (Fabricated from 1.6 mm thick GI Sheet) race ways for electrical & LV wiring including Fixing Bracket, Coupler, neoprene gasket in joints, bends, sockets cutting the floor & jamming the race way/ hanging in ceiling, supporting arrangement of all sizes at all floors	0.260%	77.299%
1	1.3.1.13	Supplying and fixing of MV distribution boards - single pole, three pole with all types of MCB, DP switch, RCCB etc. for ground, first and second floor complete	0.225%	77.524%
1	1.3.1.14	Supplying and fixing of MV distribution boards - single pole, three pole with all types of MCB, DP switch, RCCB etc. for third floor to terrace floor complete	0.225%	77.749%
1	1.3.1.15	Supplying and fixing of Main distribution boards - for light & power, UPS, ventilation, AHU's, lifts, OT's etc. for ground & first floor complete	0.630%	78.379%
1	1.3.1.16	Supplying and fixing of Main distribution boards - for light & power, UPS, ventilation, AHU's, lifts, OT's etc. for second and third floor etc. complete	0.630%	79.009%
1	1.3.1.17	Supplying and fixing of Main distribution boards - for light & power, UPS, ventilation, AHU's, lifts, OT's etc. for fourth, fifth, sixth & terrace floor etc. complete	0.610%	79.619%
1	1.3.1.18	On SITC of LED Surface / concealed mounted Down lighters as per GFC at all floors	0.018%	79.637%
1	1.3.1.19	On SITC of LED Batten in 36W / 18 W / Integral LED 4ft IP65 batten /recessed mounted 30W-3000lm Round Shape Adjustable spot light COB type, at all floors	0.020%	79.657%
1	1.3.1.20	On SITC of recessed mounted 2X2 LED panel light fixtures of al types with wattage at ground, first & second floors	0.360%	80.017%
1	1.3.1.21	On SITC of recessed mounted 2X2 LED panel light fixtures of al types with wattage at third, fourth, fifth, sixth floors	0.360%	80.377%
1	1.3.1.22	On SITC of LED based suspended standalone 4ft. Luminaire, LED strip light, bulk heads etc. at all floors	0.061%	80.438%
1	1.3.1.23	On completion of all balance miscellaneous activities related to electrical works i/c lighting conductors not mentioned above at required locations.	0.010%	80.448%
1	1.3.4	SITC of UPS system		80.448%
1	1.3.4.1	On Supply of True Modular UPS System consisting of 400 KVA /400 KW UPS Frame with 6x60 KW Hot Swappable Modules at unity power factor output to provide (n+1) redundancy to 300kVA/kW load -For Small Medical & Office Equipment	0.225%	80.673%
1	1.3.4.2	On Supply of True Modular UPS System consisting of 200 KVA + 200KVA Frame in N+N Configuration Each 200KVA with 6 x 25 KW Hot Swappable Modules at unity power factor output and expansion margin till 200KVA in future For OT	0.240%	80.913%
1	1.3.4.3	On Supply of 3 x 120kVA Monolithic UPS in parallel redundant (n+1) configuration at 0.99 input power factor with SNMP card, compatible for BMS connectivity on back net - For Hospital Elevators	0.196%	81.109%

1	1.3.5	Fire alarm system		81.109%
1	1.3.5.1	On Supplying and Laying of 2 x1.5 sqmm fire alarm armoured cable, 600/1000V rated with annealed copper conductor having XLPE insulation, steel wire armouring & FRLS outer sheath for all floors	0.111%	81.220%
1	1.3.5.2	On SITC of Addressable 2 wire Multi-Criteria Detector (Photoelectric Smoke + Heat detection) with built-in short circuit isolator, above and below ceiling at ground, first and second floors, complete	0.184%	81.404%
1	1.3.5.2	On SITC of Addressable 2 wire Multi-Criteria Detector (Photoelectric Smoke + Heat detection) with built-in short circuit isolator, above and below ceiling at third floor and above upto terrace floor complete	0.184%	81.588%
1	1.3.5.3	On SITC of Addressable 5 loop Microprocessor based intelligent and modular Fire Alarm Panel, 100% electronically addressable system & repeater panel complete as per particular specifications	0.085%	81.673%
1	1.3.5.4	On SITC of balance items like thermal heat detectors, smoke indicators, Addressable 2 wire break glass manual call point, Addressable loop powered Wall mount sounder with strobe, 2 Wire monitor module, 2 Wire Control module, Zone Fire Fighter Telephone System etc. complete	0.084%	81.757%
1	1.3.5.5	SITC of GUI based software with capacity to map the complete detector & devices of the fire alarm system.	0.021%	81.778%
1	1.3.6	Lifts		81.778%
1	1.3.6.1	On supply of 50% lifts for passengers, doctors, service, fire for all towers	0.840%	82.618%
1	1.3.6.2	On supply of 100% lifts for passengers, doctors, service, fire for all towers	0.840%	83.458%
1	1.3.6.3	On installation of 50% lifts	0.100%	83.558%
1	1.3.6.4	On installation of 100% lifts	0.100%	83.658%
1	1.3.6.5	On testing, commissioning of all lifts	0.050%	83.708%
1	1.3.6.6	On getting certificate & license of Local lift authority	0.004%	83.712%
1	1.3.7	Internal CCTV system		83.712%
1	1.3.7.1	On SITC of 24 Port POE Access Switches with switching capacity of 92 Gbps, forwarding performance 68 Mpps, having 24 x 10/100/1000BASE-T PoE (RJ45)	0.18%	83.887%
1	1.3.7.2	Supply & laying of CAT 6 U/UTP LSZH Cable, Flame Rating IEC 60332-1, 23 AWG solid copper conductors in accordance to TIA/EIA 568.2-D (Category 6) / Supply and laying of armoured 06 Core Single mode (OS2) 9/125 Fiber Cable, ITU G.652.D, G.657A1,	0.040%	83.927%
1	1.3.7.3	On SITC of 4MP@ 30 fps or better, Vari Focal Dome IR Camera having 1/3" Progressive Scan CMOS; Resolution: 2592(H) X 1520 (V) / SITC of	0.184%	84.111%

		4MP@ 30 fps or better, Outdoor type Vari Focal Bullet IR Camera having 1/3" Progressive Scan CMOS; Resolution: 2592(H) X 1520 (V) o - 50% of total cameras complete		
1	1.3.7.4	On SITC of 4MP@ 30 fps or better, Vari Focal Dome IR Camera having 1/3" Progressive Scan CMOS; Resolution: 2592(H) X 1520 (V) / SITC of 4MP@ 30 fps or better, Outdoor type Vari Focal Bullet IR Camera having 1/3" Progressive Scan CMOS; Resolution: 2592(H) X 1520 (V) o - 50% of total cameras complete	0.184%	84.295%
1	1.3.7.5	ON SITC of balance and miscellaneous items as per schedule required	0.167%	84.462%
1	1.3.7.6	On SITC of All in one solution with 64 Channel NVR/VMS Solution with full loaded licenses, SITC of Surveillance Grade 12TB SATA Hard Disk for above VMRs, complete as per schedule	0.17%	84.627%
1	1.3.8	STRUCTURED CABLING (PASSIVE), DATA, IPABX SYSTEM		84.627%
1	1.3.8.1	SITC of Category 6A U/UTP LSZH Cable, Flame Rating IEC 60332-1, 23 AWG solid copper conductors in accordance to TIA/EIA 568.2-D for all floors	0.102%	84.729%
1	1.3.8.2	On SITC of passive components complete like 6F 1U x 19" LIU Loaded / 24F 1U x 19" LIU Loaded with Single mode OS2 LC Adapters etc. as per schedule at all floors	0.019%	84.748%
1	1.3.8.3	On SITC of armoured 06 Core Single mode (OS2) 9/125 Fiber Cable, ITU G.652.D, G.657A1,	0.009%	84.757%
1	1.3.8.4	On SITC of all types of Category 6A RJ45 Unshielded Modular Jack at all floors	0.142%	84.899%
1	1.3.8.5	On SITC of balance passive items as required to complete the system	0.026%	84.925%
1	1.3.8.6	SITC of 24 Port POE Access Switches with switching capacity of 92 Gbps, forwarding performance 68 Mpps, having 24 x 10/100/1000BASE-T PoE (RJ45) with minimum PoE budget of 180W with 2 x Combo Gigabit RJ-45/ SFP ports and 2 x 10G SFP+ uplink ports complete as per specifications at all floors	0.547%	85.472%
1	1.3.8.7	SITC of Pure IP based Voice solution with 1x PRI Trunk lines (30 Ch) Circuit with CLIP Facility, 215 IP users License, 01 Nos. IP Operator Console, 28 Party Conference, Speed Dial, Music on Hold, Internal/ External ring difference, Call Barring, Call Pickup, TEC should be with GR Number complete as required.	0.168%	85.640%
1	1.3.8.8	SITC of Wireless Indoor Access Point. The AP should support 802.11ax with aggregated throughput of 1.7 Gbps. and SITC of Wireless Controller complete as per schedule for first 3 floors (GF + FF + SF)	0.284%	85.924%
1	1.3.8.9	SITC of Wireless Indoor Access Point. The AP should support 802.11ax with aggregated throughput of 1.7 Gbps. and SITC of Wireless Controller complete as per schedule for balance floors - third and above	0.287%	86.211%
1	1.3.8.10	On SITC of balance active components like fire wall, core switch, 10G Single Mode SFP+ fiber Modules etc. complete as per schedule	0.303%	86.514%

1	1.3.9	PUBLIC ADDRESS SYSTEM		86.514%
1	1.3.9.1	Supplying and Laying of 2 C X 1.5 Sq. mm multi stranded twisted shielded FRLS Copper cable.	0.013%	86.527%
1	1.3.9.2	SITC of all types Ceiling Mount Speakers & Wall Mount Speakers at all floors	0.030%	86.557%
1	1.3.9.3	SITC of 500W, Class -D Amplifier, 70/100V with rated power 500W & 6 Zone PA Controller & Voice command keypad 6 zone, with microphone assembly complete as required..	0.065%	86.622%
1	1.3.10	SITC of MATV System		86.622%
1	1.3.10.1	On laying of mild steel conduit with box	0.024%	86.646%
1	1.3.10.2	On laying of RG-11, RG-6 and cat-6 cables i/c testing, commissioning	0.010%	86.656%
1	1.4.	Fire fighting system		86.656%
1	1.4.1	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like elbows, tees, flanges, tapers, nuts - 25mm dia to 65mm dia for ground and first floors	0.189%	86.845%
1	1.4.2	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like elbows, tees, flanges, tapers, nuts - 25mm dia to 65mm dia for second and third floors	0.189%	87.034%
1	1.4.3	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like elbows, tees, flanges, tapers, nuts - 25mm dia to 65mm dia for fourth, fifth and sixth floors	0.189%	87.223%
1	1.4.4	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like elbows, tees, flanges, tapers, nuts - 80mm dia to 100mm dia for ground, first & second floors	0.119%	87.342%
1	1.4.5	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like elbows, tees, flanges, tapers, nuts - 80mm dia to 100mm dia for third & above floors	0.119%	87.461%
1	1.4.6	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like elbows, tees, flanges, tapers, nuts - 150mm dia for 50% of total length	0.146%	87.607%
1	1.4.7	Providing, laying, testing & commissioning of 'B' class heavy duty G.I. pipe 80mm dia at all floors	0.023%	87.630%
1	1.4.8	Supplying and fixing single headed Stainless steel internal hydrant valve with instantaneous Stainless Steel coupling of 63 mm dia with cast iron wheel at all floors	0.026%	87.656%
1	1.4.9	SITC of butterfly valve of PN 1.6 rating with bronze / gunmetal seat duly ISI marked complete with nuts, bolts, washers, gaskets of all sizes 80/100/150 mm dia at all floors	0.040%	87.696%
1	1.4.10	Supplying and fixing 40m long first-aid Hose Reel with MS construction spray painted in post	0.051%	87.747%

		office red, conforming to IS 884 complete at all floors		
1	1.4.11	Supplying and fixing 63 mm dia, 15 m long RRL hose pipe with 63 mm dia male and female couplings duly bound with GI wire, rivets etc. conforming to IS 636 (type-A) stainless steel grade 304 at all floors	0.039%	87.786%
1	1.4.12	Providing, fixing, testing & commissioning of 15mm dia quartzoid bulb type sprinklers of rating 68 degree centigrade with required accessories - pendent / upright for ground, first and second floors	0.090%	87.876%
1	1.4.13	Providing, fixing, testing & commissioning of 15mm dia quartzoid bulb type sprinklers of rating 68 degree centigrade with required accessories - pendent / upright for third and above floors	0.090%	87.966%
1	1.4.14	SITC of sprinkler flexible pipe (UL Listed) of stainless steel complete of length 700mm / 1000mm / 1200mm for ground, first and second floors	0.131%	88.097%
1	1.4.15	SITC of sprinkler flexible pipe (UL Listed) of stainless steel complete of length 700mm / 1000mm / 1200mm for third and above floors	0.131%	88.228%
1	1.5.1	HVAC - low side works		88.228%
1	1.5.1.1	On Supplying and fixing of mild steel chilled water piping with 75mm insulation at all floors - 150mm / 250 mm dia	0.121%	88.349%
1	1.5.1.2	On Supplying and fixing of mild steel chilled water piping with 50mm insulation at GF, FF & second floors - 20mm to 125 mm dia	0.212%	88.561%
1	1.5.1.3	On Supplying and fixing of mild steel chilled water piping with 50mm insulation at TF, fourth, fifth & sixth floors - 20mm to 125 mm dia	0.212%	88.773%
1	1.5.1.4	On Supplying and fixing of factory fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets of all thickness at ground, first & second floors	0.274%	89.047%
1	1.5.1.5	On Supplying and fixing of factory fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets of all thickness at third and above floors	0.274%	89.321%
1	1.5.1.6	On Supplying and fixing of site fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets of all thickness at all floors	0.061%	89.382%
1	1.5.1.7	On SITC of floor mounted air handling units for non critical areas of various airflows as per schedule & GFC - 33% of total AHU nos.	0.228%	89.610%
1	1.5.1.8	On SITC of floor mounted air handling units for non critical areas of various airflows as per schedule & GFC - 66% of total AHU nos.	0.228%	89.838%
1	1.5.1.9	On SITC of floor mounted air handling units for non critical areas of various airflows as per schedule & GFC - 100% of total AHU nos.	0.228%	90.066%
1	1.5.1.10	On SITC of floor mounted air handling units for critical areas of various airflows as per schedule & GFC - 33% of total AHU nos.	0.261%	90.327%

1	1.5.1.11	On SITC of floor mounted air handling units for critical areas of various airflows as per schedule & GFC - 66% of total AHU nos.	0.261%	90.588%
1	1.5.1.12	On SITC of floor mounted air handling units for critical areas of various airflows as per schedule & GFC - 100% of total AHU nos.	0.261%	90.849%
1	1.5.1.13	On SITC of floor mounted air handling units for OT of various airflows as per schedule at OT floors	0.066%	90.915%
1	1.5.1.14	On SITC of internal AC ducting of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel / Board should be CFC/HCFC Free Green Pro & GRIHA Certified, Thickness is 20mm, Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, complete as per specification for ground floor complete	0.292%	91.207%
1	1.5.1.14	On SITC of internal AC ducting of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel / Board should be CFC/HCFC Free Green Pro & GRIHA Certified, Thickness is 20mm, Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, complete as per specification for first floor complete	0.292%	91.499%
1	1.5.1.14	On SITC of internal AC ducting of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel / Board should be CFC/HCFC Free Green Pro & GRIHA Certified, Thickness is 20mm, Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, complete as per specification for second floor complete	0.292%	91.791%
1	1.5.1.14	On SITC of internal AC ducting of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel / Board should be CFC/HCFC Free Green Pro & GRIHA Certified, Thickness is 20mm, Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, complete as per specification for third floor complete	0.292%	92.083%
1	1.5.1.14	On SITC of internal AC ducting of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel / Board should be CFC/HCFC Free Green Pro & GRIHA Certified, Thickness is 20mm, Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, complete as per specification for fourth floor complete	0.292%	92.375%
1	1.5.1.14	On SITC of internal AC ducting of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel / Board should be CFC/HCFC Free Green Pro & GRIHA Certified, Thickness is 20mm, Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, complete as per specification for fifth floor complete	0.292%	92.667%

1	1.5.1.14	On SITC of internal AC ducting of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel / Board should be CFC/HCFC Free Green Pro & GRIHA Certified, Thickness is 20mm, Density of PIR foam 45 kg/m ³ , Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, complete as per specification for sixth floor complete	0.292%	92.959%
1	1.5.1.13	SITC of electrostatic filter single module - 1000 cfm as per specifications, complete	0.158%	93.117%
1	1.5.1.14	SITC of electrostatic filter single module - 2000 cfm as per specifications, complete	0.372%	93.489%
1	1.5.1.15	On SITC of Pressure independent variable air volume Terminal units 100 to 3000 cfm , suitable for installation in horizontal ducts as per schedule complete at all floors.	0.292%	93.781%
1	1.5.1.16	On SITC of Heat recovery units of all sizes factory fabricated Double skinned construction with Thermal Break Profile with (0.8mm) pre coated GSS from outside & (0.8mm) GSS on inside with PUF Insulation at ground, first and second floors	0.239%	94.020%
1	1.5.1.16	On SITC of Heat recovery units of all sizes factory fabricated Double skinned construction with Thermal Break Profile with (0.8mm) pre coated GSS from outside & (0.8mm) GSS on inside with PUF Insulation at third & above floors	0.239%	94.259%
1	1.5.1.17	On SITC of AHU coil mounted UVGI system of all sizes at all floors	0.266%	94.525%
1	1.5.1.18	On SITC of Duct/Plenum mounted UVGI system of all sizes at all floors	0.178%	94.703%
1	1.5.1.19	On SITC of HVAC dedicated VFDs suitable for the 4/2.2/1.5 KW AHU fan motor capacity with IP 21 complete as per specifications at all floors	0.244%	94.947%
1	1.5.1.20	On SITC of powder coated extruded aluminium Supply Air Grills/ exhaust with aluminium volume control dampers / supply / return grills with louvers, return air diffusers as at all floors per specifications.	0.182%	95.129%
1	1.5.1.21	On completion of balance items as required to complete the system as pr GFC drawings and schedules at all floors	1.075%	96.204%
1	1.6.1	Pressurized mechanical ventilation system		96.204%
1	1.6.1	On SITC of smoke exhaust long casing (GSS) Vane/Tube Axial flow type fans, complete of various cfm's at various locations.	0.158%	96.362%
1	1.6.2	On SITC of supply air long casing(GSS) Vane/Tube Axial flow type fans complete with aluminium alloy blades with aero foil design, bird screen, flexible connection & gravity louvers complete of various cfm's at various locations.	0.159%	96.521%
1	1.6.3	On SITC of air washer CELDEK FILL package type air cooling unit with minimum 90% saturation efficiency	0.045%	96.566%
1	1.6.4	On SITC of in line fans at all floors of required cfm	0.009%	96.575%
1	1.6.5	On SITC of tube axial flow fans long casing(GSS) Vane/Tube Axial flow type supply	0.073%	96.648%

		air fans complete with aluminium alloy blades with aero foil design, bird screen, flexible connection & gravity louvers at outlet of various cfm's at various locations.		
1	1.6.6	On SITC of centrifugal fans with cabinet DIDW centrifugal fan, GI construction of various cfm's at various locations.	0.061%	96.709%
1	1.6.7	On SITC of wall mounted propeller type exhaust fans shall be of Axial Flow type with light weight type PVC/ aluminium impellers with aero foil contours for high efficiency and low noise of 450/230/150 mm at various locations.	0.003%	96.712%
1	1.15	Internal Signages In Building		96.712%
1	1.15.1	On supply & fixing of internal signage for fire, lifts, rooms, corridors, lobbies staircases etc. as per GFC drawings	0.036%	96.748%
1	1.16	MEDICAL GAS PIPELINE SYSTEM		96.748%
1	1.16.1	SITC of Medical Grade Copper Tube/Pipes including all type of accessories Like, Tee, Elbow, Valves, etc. complete from 12mm to 22mm OD for ground & first floor complete	0.188%	96.936%
1	1.16.2	SITC of Medical Grade Copper Tube/Pipes including all type of accessories Like, Tee, Elbow, Valves, etc. complete from 12mm to 22mm OD for second & third floor complete	0.188%	97.124%
1	1.16.3	SITC of Medical Grade Copper Tube/Pipes including all type of accessories Like, Tee, Elbow, Valves, etc. complete from 12mm to 22mm OD for fourth, fifth & sixth floor complete	0.188%	97.312%
1	1.16.4	SITC of Medical Grade Copper Tube/Pipes including all type of accessories Like, Tee, Elbow, Valves, etc. complete from 28mm to 42mm OD for all floors complete	0.342%	97.654%
1	1.16.5	SITC of Medical Grade Copper Tube/Pipes including all type of accessories Like, Tee, Elbow, Valves, etc. complete from 54mm to 108mm OD for all locations complete	0.320%	97.974%
1	1.16.6	SITC of Quadplex Compressed Air system complete with minimum capacity 04 nos. The medical air compressors should be of oil-lubricated rotary screw air-cooled design . Each air compressor should have a requisite capacity at 3000lpm to formulate the total plant capacity of 10000 LPM as primary and 10000 LPM of secondary.	0.230%	98.204%
1	1.16.7	SITC of Quadplex Vacuum Central System Complete with 04 nos. Rotary vane vacuum pumps, Total plant capacity 6500 LPM as Primary with additional full capacity standby system as per relevant standard with Filter, interconnecting pipes, NRV, auto switch gear assy., exhaust silencer , vacuum receiver, bacterial filter, vacuum gas outlets etc. complete	0.387%	98.591%
1	1.16.8	SITC of Bed Head Panel without Out - Let - 2 / 3 / 6 gas outlet at all floors	0.323%	98.914%
1	1.16.9	SITC of Oxygen system complete at all locations.	0.179%	99.093%
1	1.16.10	SITC of Nitrous Oxide System complete at all locations.	0.012%	99.105%

1	1.16.11	SITC of Carbon Oxide System complete at all locations.	0.016%	99.121%
1	1.16.12	SITC of medical compressed air system consisting of receiver, filtration system, gas outlets, etc. complete at all locations	0.125%	99.246%
1	1.16.13	SIT of all types of valves, AGSS plant system, Digital alarm system, miscellaneous items	0.146%	99.392%
1	1.17	Nurse calling System		99.392%
1	1.17.1	Supply & laying of ISI marked 25 mm conduit with accessories at all floors	0.010%	99.402%
1	1.17.2	Supply and laying including termination of cabling in existing conduits including terminations (RJ45) at all floors	0.019%	99.421%
1	1.17.3	Supply, Installation testing & commissioning of UL/ VDE 0834 certified/ approved System Switch/ Controller at all locations as per GFC drawings.	0.060%	99.481%
1	1.17.4	On SITC of UL/ VDE 0834 certified/ approved Nurse Station Terminal at all locations as per GFC drawings.	0.112%	99.593%
1	1.17.5	Supply and fixing of External Monitor - To display call generation on external bigger display	0.045%	99.638%
1	1.17.6	ON SITC of UL/ VDE 0834 certified/ approved Patient Handset - Without Speech	0.084%	99.722%
1	1.17.7	ON SITC of UL/ VDE 0834 certified/ approved Bed Head Unit for Patient Terminal	0.081%	99.803%
1	1.17.8	On SITC of UL/ VDE 0834 certified/ approved Backbone Switch:	0.039%	99.842%
1	1.17.9	on SITC of balance items as per schedule and specifications	0.158%	100.000%
1		TOTAL	100.000%	
2	2.1	Completion of Academic cum R & D Building in all respects as per scope of work (95.00% of the Quoted Amount for Item No. 2.0 of Financial Quote Part H) & as per NIT		
2	2.1.1	Excavation, Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 50% of total no.	2.700%	2.700%
2	2.1.2	Excavation, Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 100% of total no.	2.700%	5.400%
2	2.1.3	Testing of piles - Initial and routine and Integrity	0.120%	5.520%
2	2.1.4	Laying lean concrete below pile caps, raft - 50% area of total area	0.200%	5.720%
2	2.1.5	Laying lean concrete below pile caps, raft - 100% area of total area	0.200%	5.920%
2	2.1.6	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -50% Area of total	2.870%	8.790%
2	2.1.7	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -100% Area total	2.870%	11.660%
2	2.1.8	Casting RCC columns, shear walls, lift retaining wall upto bottom of grade slab i/c reinforcement, form work	0.760%	12.420%

2	2.1.9	Filling earth over RCC caps, raft, ground i/c compaction to 95% proctor's density - 100% of total area	0.310%	12.730%
2	2.1.10	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 50% of total area	0.390%	13.120%
2	2.1.11	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 100% area of total	0.390%	13.510%
2	2.1.12	Casting RCC columns, shear walls, lift walls up to Ground Floor roof slab Level - 100% area	1.180%	14.690%
2	2.1.13	Casting of RCC staircase, beam and slab of Ground floor roof - 100% area	2.770%	17.460%
2	2.1.14	Casting RCC columns, shear walls, lift walls up to First Floor roof slab Level - 100% area	1.180%	18.640%
2	2.1.15	Casting of RCC staircase, beam and slab of First floor roof - 100% area	2.770%	21.410%
2	2.1.16	Casting RCC columns, shear walls, lift walls up to Second Floor roof slab Level - 100% area	1.180%	22.590%
2	2.1.17	Casting of RCC staircase, beam and slab of second floor roof - 100% area	2.770%	25.360%
2	2.1.18	Casting RCC columns, shear walls, lift walls up to Third Floor roof slab Level - 100% area	1.180%	26.540%
2	2.1.19	Casting of RCC staircase, beam and slab of Third floor roof - 100% area	2.770%	29.310%
2	2.1.20	Casting RCC columns, shear walls, lift walls up to Fourth Floor roof slab Level - 100% area	1.180%	30.490%
2	2.1.21	Casting of RCC staircase, beam and slab of Fourth floor roof - 100% area	2.770%	33.260%
2	2.1.22	Casting of RCC staircase, column, beam and slab, water tank and all other RCC work at terrace floor - 100% area	1.160%	34.420%
2	2.1.23	Providing Antitermite treatment to all blocks & misc. items to complete the structural RCC works	0.480%	34.900%
2	2.1.24	Structural steel work		34.900%
2	2.1.25	Providing Structural steel work in hollow round pipes in façade and built up sections i/c foundation plates, i/c fabricating, erecting, exterior grade primer and exterior grade PU painting etc. complete	1.630%	36.530%
2	2.1.26	Providing Structural steel work built up sections at terrace level i/c fabricating, erecting, primer and painting etc. complete	0.240%	36.770%
2	2.1.26	Providing steel work for various misc. works with primer and painting etc. complete at all floors.	0.350%	37.120%
2	2.1.27	Completion of all Masonry walls including RCC lintels, bands, mullions, stub columns with reinforcement and form work etc.		37.120%
2	2.1.28	All Masonry works for Ground Floor Level	0.990%	38.110%
2	2.1.29	All Masonry works for First Floor Level	0.990%	39.100%
2	2.1.30	All Masonry works for second Floor Level	0.990%	40.090%

2	2.1.31	All Masonry works for third Floor Level	0.990%	41.080%
2	2.1.32	All Masonry works for fourth Floor Level	0.990%	42.070%
2	2.1.33	On completion of Masonry work up to terrace slab, Mumty, lift Machine room & terrace parapets.	0.026%	42.096%
2	2.1.34	Internal plaster works on ceiling, walls		42.096%
2	2.1.35	Completion of internal plaster work up to Ground & First Floor Level	0.270%	42.366%
2	2.1.36	Completion of internal plaster work up to Second & Third Floor Level	0.270%	42.636%
2	2.1.37	Completion of internal plaster work up to Fourth Floor Level, terrace floor, Mumty, lift Machine room	0.160%	42.796%
2	2.1.38	External wall Finishing with Sintered porcelain large tiles / plaster from ground to parapet, Mumty top level		42.796%
2	2.1.39	External waterproof plaster below tile cladding / mumty / parapet on walls	0.033%	42.829%
2	2.1.40	Sintered large porcelain tile cladding system - 50% area of total	4.180%	47.009%
2	2.1.41	Sintered large porcelain tile cladding system - 100% area of total	4.180%	51.189%
2	2.1.42	Completion of stone / tiles flooring, PCC floor including skirting, PCC required in sunken areas and below tile flooring to match levels at all levels		51.189%
2	2.1.43	Lean PCC below floors in sunken areas, leveling concrete in M10 / PCC 1:3:6 over AAC Broken blocks filling	0.070%	51.259%
2	2.1.44	Cement concrete flooring in mix 1:2:4 of required thickness below vinyl , laminated HDF flooring	0.015%	51.274%
2	2.1.45	Polished granite minimum 18mm thick on counters, sills, ledge i/c moulding, polishing at all floors	0.057%	51.331%
2	2.1.46	Polished and anti skid vitrified tile flooring & skirting with epoxy grouting of required size / shape and thickness at all floors	3.520%	54.851%
2	2.1.47	Granite flooring in steps, s/c skirting and other areas as per drawings, at all floors including moulding, grinding and polishing.	0.550%	55.401%
2	2.1.48	Kota stone flooring minimum 25mm thick, skirting and grinding and polishing.	0.420%	55.821%
2	2.1.49	Completion of Waterproofing works i/c gola, plaster		55.821%
2	2.1.50	Terraces i/c mumty roof waterproofing with brick bat coba treatment, concrete golas, khurras at all blocks	0.630%	56.451%
2	2.1.51	Waterproofing of sunken areas of toilets, kitchen, pantry, balconies etc. i/c protection plaster at all levels. Waterproofing of OH water tanks.	0.140%	56.591%
2	2.1.52	Polyurea Waterproofing minimum 2 coats of landscape terrace / open terraces at lower floors i/c grading with concrete in slope, insulation	0.410%	57.001%

2	2.1.53	Completion of aluminium rough sub frame, powder coated extruded aluminium profile door frames		57.001%
2	2.1.54	Natural aluminium rectangular tube subframe for doors, windows, ventilators, glazing's	0.100%	57.101%
2	2.1.55	Powder coated aluminium extruded profile size section 100mm x 55mm x 2mm thick fixed with fasteners	0.200%	57.301%
2	2.1.56	Completion of all ceramic & vitrified tile dado, granite dado, including window sills and jambs etc.		57.301%
2	2.1.57	Vitrified /ceramic tile dado in toilets, kitchen, pantry at all floors	0.290%	57.591%
2	2.1.58	Polished granite dado, bands, in lift lobbies, corridors etc. at all floors	0.540%	58.131%
2	2.1.59	On Completion of external Curtain glazing / Structural Glazing with DGU's, spandrel panel, insulation, Aluminum Panels, , etc.		58.131%
2	2.1.60	Supplying, fabricating, installing polyester powder coated curtain wall / structural glazing system on external façade as per elevations	1.680%	59.811%
2	2.1.61	Supplying, fabricating and installing powder coated windows / ventilator shutters with SS stays, openable shutters in CW glazing	0.180%	59.991%
2	2.1.62	Providing, assembling and supplying vision glass panels (IGUs) comprising of hermetically-sealed 6-12- 6 mm insulated glass (double glazed) vision panel units -Coloured tinted float glass 6mm thick substrate with reflective soft coating on face # 2, + 12mm Airgap + 6mm Heat Strengthened clear Glass - SKN including testing of system for wind pressure, water infiltration.	0.940%	60.931%
2	2.1.63	Providing and supplying Spandrel Glass Panels comprising of 6 mm thick heat strengthened monolithic float glass of approved colour and shade with reflective soft coating on surface # 2, shadow box complete	0.220%	61.151%
2	2.1.64	On completion of False ceiling works complete		61.151%
2	2.1.65	Providing Mineral fibre tiles false ceiling tiles of minimum size 595X595mm of approved texture, design and pattern of all NRC's with approved grid at all floors	1.450%	62.601%
2	2.1.66	Providing and fixing wooden finish U Baffle Aluminium panel ceiling as approved at all floors	1.200%	63.801%
2	2.1.67	GI Metal false Ceiling Lay in perforated Tegular edge global white color tiles of size 595x595 mm and 0.5 mm thick with 8 mm drop with grid at all floors	0.590%	64.391%
2	2.1.68	12.5 mm thick tapered edge gypsum plain board / MR grade i/c frame work at all floors i/c making coves, providing trap doors	0.480%	64.871%
2	2.1.69	Providing calcium silicate board grid ceiling with powder coated frame work i/c bulk heads for grid ceiling, trap doors	0.570%	65.441%
2	2.1.70	On Completion of external louvers, WCP jalli / screens, ACP sheet cladding work complete		65.441%
2	2.1.71	Supply and installation of Z shape louvers polyester powder coated minimum 60 micron fixed with anchor fasteners at all levels.	0.860%	66.301%

2	2.1.72	Supply and installation of mild steel frame work for aluminium louvers, WPC screens, ACP Cladding on portal etc. i/c primer and anti rust painting.		66.301%
2	2.1.73	Supply and installation of aluminium composite panel cladding on portal, other elements as per elevations, drawings at all levels.	1.970%	68.271%
2	2.1.74	Supply and installation of wood composite panels / screens / jalis as per elevations, drawings at all levels.		68.271%
2	2.1.75	On completion of internal / external white cement based putty, anti bacterial plastic emulsion painting, oil bound distempering, white washing, enamel painting and finishing work		68.271%
2	2.1.76	White cement based putty on ceiling and walls at all floors	0.530%	68.801%
2	2.1.77	Oil bound distemper, Synthetic enamel painting, while washing, primer on walls, ceiling, lift wells, shafts at all levels	0.050%	68.851%
2	2.1.78	Exterior grade emulsion paint with primer on exterior surfaces at terrace and parapets at all levels	0.030%	68.881%
2	2.1.79	Anti bacterial plastic emulsion paint on ceiling and walls at all floors	0.660%	69.541%
2	2.1.80	On completion of fire doors, shaft doors i/c hardware		69.541%
2	2.1.81	Supply and installation of 120 minutes fire rated door frame and shutters with or without fire rated vision panel glass, SS butt hinges, sealing of joints of frame and walls	0.360%	69.901%
2	2.1.82	Supplying and fixing SS fire rated hardware for fire and shaft doors like panic bar, trim, door closers, tower bolt, coordinator	0.070%	69.971%
2	2.1.83	On completion of glass doors, glass paneling and mirrors etc.		69.971%
2	2.1.84	Providing and fixing 12mm thick frameless plate glass door shutters, glass panes in windows, ventilators, fixed glazing tempered / non tempered / mirrors in toilets	0.140%	70.111%
2	2.1.85	Providing and fixing 6mm thick lacquered glass paneling on walls in lobbies	0.120%	70.231%
2	2.1.86	On fixing of laminated flush door shutters with hinges at all floors	0.480%	70.711%
2	2.1.87	On completion of interior wall finishing with acoustic panels, rigid vinyl sheet, HPL board etc.		70.711%
2	2.1.88	Providing and installation of acoustical wall paneling with frame work at all floors	1.000%	71.711%
2	2.1.89	Providing and fixing Interior wall area with fabric panels, prelaminated board and all other finishes except acoustic panels, painting, vitrified tile cladding	0.137%	71.848%
2	2.1.90	On completion of interior flooring & skirting finishing - False floors, laminated HDF flooring, skirting profiles, anti slip strip on treads		71.848%
2	2.1.91	Providing and fixing 8mm thick HDF laminated plank flooring i/c skirting profile, False flooring tile system in server room	0.070%	71.918%
2	2.1.92	On completion of stainless steel 304 grade railing, glass railings with stainless steel supports		71.918%

2	2.1.93	Stainless steel 304 grade railings for staircases, balconies, terraces, double height areas, lobbies etc.	0.620%	72.538%
2	2.1.94	Providing and fixing 1200mm high Laminated toughened glass railing (6 mm clear glass FT + 1.52 mm pvb film + 6 mm clear glass FT) with SS 316 adaptor & SS 316 balusters	0.130%	72.668%
2	2.1.95	On completion of All type of door, windows, ventilators hardware		72.668%
2	2.1.96	All hardware like stainless steel 304 grade handles, tower bolts, mortice locks, cylinders, door stoppers, door buffers, SS kick plates, push plates, mop plates, floor springs, SS sign plates, SS door handles at all floors	0.560%	73.228%
2	2.1.97	Door closers of all types at all floors	0.152%	73.380%
2	2.1.98	On completion of All toilet / bath cubicles & urinal partition		73.380%
2	2.1.99	Toilet cubicles made from 12mm thick HPL board with all accessories as per GFC drawings & HPL urinal partitions	0.260%	73.640%
2	2.1.100	Fixed laminated cabinets for kitchen, pantry, toilets		73.640%
2	2.1.101	Providing fixed laminated cabinets made from MR grade commercial board and pasted with 1 mm thick laminate on all sides, lock, SS handles complete	0.100%	73.740%
2	2.1.102	On completion of entire work including treatment of Column guards, Roller Blinds, Curtains signage's, etc.		73.740%
2	2.1.103	On completion of treatment of Column guards, signage's, Roller Blinds, Curtains etc.	0.150%	73.890%
2	2.1.104	On completion of various small items not mentioned above but shown in drawings / required for completion	0.137%	74.027%
2	2.20	Internal Water supply, Sanitary Installation and Drainage work up to first manhole including preparation of shop drawings		74.027%
2	2.2.1	Completion of Internal grid of water supply CPVC concealed and exposed piping 20mm to 40mm dia for ground and first floor level i/c thermal insulation complete	0.089%	74.116%
2	2.2.2	Completion of Internal grid of water supply CPVC concealed and exposed piping 20mm to 40mm dia for second and third floor level i/c thermal insulation complete	0.089%	74.205%
2	2.2.3	Completion of Internal grid of water supply CPVC concealed and exposed piping 20mm to 40mm dia for fourth and terrace floor level i/c thermal insulation complete	0.044%	74.249%
2	2.2.4	Completion of exposed CPVC SCH-40 piping 50mm to 150mm dia up to Terrace Floor level and terrace water tanks	0.080%	74.329%
2	2.2.5	Completion of sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, with all necessary fittings from 40mm to 160mm dia at ground and first floor levels	0.153%	74.482%
2	2.2.6	Completion of sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, with all necessary fittings from 40mm to 160mm dia at second and third floor levels	0.160%	74.642%

2	2.2.7	Completion of sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, with all necessary fittings from 40mm to 160mm dia at fourth, and terrace floor levels	0.077%	74.719%
2	2.2.8	On fixing of forged brass ball valves , butter fly valves, All other valves.	0.047%	74.766%
2	2.2.9	On completion of uPVC pipes 110mm / 160mm OD pipe i/c fittings like P-traps etc. complete at all locations	0.220%	74.986%
2	2.2.10	SITC of MHot Water circulation Pumps in Heat pump and tank. (For 70 KW Heat Pump) 2 nos + 1 stand by	0.028%	75.014%
2	2.2.11	SITC of stainless steel R.O water storage tank (SS 316) with minimum thickness of shell is 3 mm and base is 3 mm placed at terrace level with inlet, outlet, overflow connection complete - 500 litres cap.	0.016%	75.030%
2	2.2.12	SITC of skid mounted fully automatic Reverse Osmosis System of output capacity 100 litres / hour designed at a minimum Flux at inlet complete with fittings, valves, meters etc. as required	0.080%	75.110%
2	2.2.13	On supply and fixing of white vitreous china wash basin with special fabricated brackets painted white, faucets as required, 32 mm C.P. brass waste.32 mm C.P. brass bottle trap & pipe to wall with rubber adopter for waste connection and C.P. brass wall flange	0.060%	75.170%
2	2.2.14	On supply and fixing urinals with fittings complete	0.120%	75.290%
2	2.2.15	Supply and fixing of water supply fittings and fixtures - CP mixer, faucet, bib cock, toilet paper holder, grab bar, soap dish etc. all complete	0.170%	75.460%
2	2.2.16	Supply and fixing of wall hung WC with cover - 100% of total nos.	0.100%	75.560%
2	2.2.17	Providing and fixing 150 litre/ hr. cooling and storage capacity, fully stainless steel electric storage type water cooler complete in all respect.	0.210%	75.770%
2	2.2.18	On completion of all items not mentioned above but shown in GFC drawings / required to complete work	0.030%	75.800%
2	2.2.19	On completion of entire work and testing	0.014%	75.814%
2	2.3	E & M Works of Academic Building		75.814%
2	2.3	Internal Electrical works including MDB's, Light Fixture, fans		75.814%
2	2.3.1	Laying of Conduit and junction boxes for light / ceiling fan / exhaust fan points, light & power plugs for all floors in recess / surface complete	0.240%	76.054%
2	2.3.2	Drawing PVC insulated copper wires 1.5 sqmm in conduits for light / ceiling fan / exhaust fan points, call bell points for all floors complete	0.240%	76.294%
2	2.3.3	Fixing of modular switches & connections at all floors for light / ceiling fan / exhaust fan points, call bell points, complete	0.330%	76.624%
2	2.3.4	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 1 No. 4 sq. mm FRLS PVC insulated copper	0.580%	77.204%

		conductor single core cable for loop earthing for all floors complete		
2	2.3.5	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for all floors complete	0.430%	77.634%
2	2.3.6	Supplying and fixing of PVC conduit 25mm / 32mm along with accessories in surface/recess for circuit wiring etc. and other services like fire alarm wiring	0.360%	77.994%
2	2.3.7	Wiring for circuit/ submain wiring along with earth wire with various sizes of FRLS PVC insulated copper conductor, single core cable at all floors in MS conduits - 1.5 sqmm to 16 sqmm.	2.310%	80.304%
2	2.3.8	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections and 6 pin 5/6 A & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. at all floors	0.090%	80.394%
2	2.3.9	Supplying and fixing of MV distribution boards - single pole, three pole with all types of MCB, DP switch, RCCB etc. for all floors complete	0.200%	80.594%
2	2.3.10	Supplying and fixing of Main MV panels - for light & power, UPS, ventilation, AHU's, lifts, etc. for all floors etc. complete	1.230%	81.824%
2	2.3.11	Supplying and fixing of Main distribution boards - for light & power, for all floors etc. complete	0.600%	82.424%
2	2.3.12	On SITC of LED Surface / concealed mounted Down lighters as per GFC at all floors	0.270%	82.694%
2	2.3.13	On SITC of LED Batten in 36W / 18 W / Integral LED 4ft IP65 batten /recessed mounted 30W-3000lm Round Shape Adjustable spot light COB type, at all floors	0.065%	82.759%
2	2.3.14	On SITC of recessed mounted 2X2 LED panel light fixtures of all types with wattage at all floors	0.730%	83.489%
2	2.3.15	On SITC of LED based suspended standalone 4ft. Luminaire, LED strip light, bulk heads etc. at all floors	0.093%	83.582%
2	2.3.16	On SITC of ceiling fans at all floors	0.154%	83.736%
2	2.3.17	On SITC of lighting protection and earthing system complete	0.130%	83.866%
2	2.3.18	ON SITC of all sizes cable trays at all floors	0.290%	84.156%
2	2.3.19	On SITC of all cables as per schedule at all floors to complete the work	0.110%	84.266%
2	2.3.20	On completion of all balance miscellaneous activities related to electrical works i/c lighting conductors not mentioned above at required locations.	0.010%	84.276%
2	2.4.	Fire fighting system		84.276%
2	2.4.1	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like	0.005%	84.281%

		elbows, tees, flanges, tapers, nuts - 25mm dia to 65mm dia for all floors		
2	2.4.2	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589/IS 1239 including Welding, fittings like elbows, tees, flanges, tapers, nuts - 80mm dia to 150mm dia for all locations	0.180%	84.461%
2	2.4.3	Providing, laying, testing & commissioning of 'B' class heavy duty G.I. pipe 80mm dia at all floors	0.029%	84.490%
2	2.4.4	Supplying and fixing single headed Stainless steel internal hydrant valve with instantaneous Stainless Steel coupling of 63 mm dia with cast iron wheel at all floors	0.037%	84.527%
2	2.4.5	SITC of butterfly valve of PN 1.6 rating with bronze / gunmetal seat duly ISI marked complete with nuts, bolts, washers, gaskets of all sizes 80/100/150 mm dia at all floors	0.047%	84.574%
2	2.4.6	Supplying and fixing 40m long first-aid Hose Reel with MS construction spray painted in post office red, conforming to IS 884 complete at all floors	0.075%	84.649%
2	2.4.7	Supplying and fixing 63 mm dia, 15 m long RRL hose pipe with 63 mm dia male and female couplings duly bound with GI wire, rivets etc. conforming to IS 636 (type-A) stainless steel grade 304 at all floors	0.056%	84.705%
2	2.4.8	Providing and fixing MS partly glazed single/double hung lockable shutter fabricated from MS section as required with 5 mm thick glass for fire station complete as per specifications	0.064%	84.769%
2	2.4.9	SITC of electric driven terrace pump 900 LPM with MCC panel suitable for automatic operation and consisting of air vessel, pressure gauge, bridge connection misc. items to complete fire fighting system complete in all respects,	0.110%	84.879%
2	2.4.10	Providing and fixing carbon-di-oxide type fire extinguishers capacity 4.5 kg as per specifications, complete at all floors	0.115%	84.994%
2	2.4.11	Providing and fixing ABC Powder type fire extinguishers capacity 6 kg. as per specifications complete with internal charge.	0.054%	85.048%
2	2.5.1	On SITC 2 no 120 KVA rating UPS in paralleling mode at 0.99 input power factor with SNMP card, compatible for BMS connectivity on back net/MODBUS, as per particular specification given in the document.	1.240%	86.288%
2	2.6.1	Fire alarm system		86.288%
2	2.6.1	On Supplying and Laying of 2 x1.5 sqmm fire alarm armoured cable, 600/1000V rated with annealed copper conductor having XLPE insulation, steel wire armouring & FRLS outer sheath for all floors	0.200%	86.488%
2	2.6.2	SITC of central graphical fire alarm management system to centrally monitor and operate the fire alarm system complete as required.	0.052%	86.540%
2	2.6.3	On SITC of Addressable 2 wire Multi-Criteria Detector (Photoelectric Smoke + Heat detection) with built-in short circuit isolator, above and below ceiling at third floor and above upto terrace floor complete	0.410%	86.950%

2	2.6.4	On SITC of 4 loop micro processor based intelligent addressable main fire alarm panel, central processing unit complete system as per specifications volt sealed maintenance free batteries with automatic charger. The panel shall have facility to connect printer to printout log and facility to have seamless integration with analog/digital voice evacuation system complete as per specifications.	0.070%	87.020%
2	2.6.5	SITC of repeater panel with 320 character/ Touch screen LCD display with inbuilt reset, acknowledge and silence switches complete as required.	0.030%	87.050%
2	2.6.6	SITC of addressable beam detector with short circuit isolator (inbuilt or separate) complete with emitter and receiver including connections with remote test features etc. complete as required.	0.078%	87.128%
2	2.6.7	Supply, Installation, testing and Commissioning of Exit Signage Light with 3hrs Battery Backup Twin Side available in Green/Red Colour.	0.050%	87.178%
2	2.6.8	On SITC of balance items like thermal heat detectors, smoke indicators, Addressable 2 wire break glass manual call point, Addressable loop powered Wall mount sounder with strobe, 2 Wire monitor module, 2 Wire Control module, Zone Fire Fighter Telephone System etc. complete	0.330%	87.508%
2	2.7.	Lifts		87.508%
2	2.7.1	On supply of 100% machine room less lifts for passengers as per lift schedule	1.562%	89.070%
2	2.7.4	On installation of 100% lifts	0.210%	89.280%
2	2.7.5	On testing, commissioning of all lifts	0.210%	89.490%
2	2.7.6	On getting certificate & license of Local lift authority	0.100%	89.590%
2	2.8.	Internal CCTV system & Access Control System		89.590%
2	2.8.1	SITC of loaded 24-Port 1U loaded Universal Modular Straight Patch Panel, pre loaded with cable support Bar, Complete as per spec	0.067%	89.657%
2	2.8.2	On SITC of Dome Camera, / Bullet Camera Resolution upto 5 MP , Quad stream with each stream support H.265 complete as per specifications	0.117%	89.774%
2	2.8.3	ON SITC of Workstation PC: Intel(R) Core(TM) i7-3770 Processor (8M Cache, up to 3.90 GHz); RAM: 8GB (1x8GB) Non-ECC DDR3 1600MHz; Keyboard: 12 function keys; Chassis: Tower/Workstation; DVD: 8X Slimline DVD+/-RW, Data Only; Dual Graphics Card; Network interface card: Integrated Intel(R) 82579LM Gigabit1 Ethernet LAN 10/100/1000; Hard disk: 250GB, 7200 RPM 3.5" SATA 6Gb/s Hard Drive; Operating system: Windows 7 Professional 64 Bit or latest., Full HD 55" TV	0.050%	89.824%
2	2.8.4	On SITC of 64 channel NVR, ONVIF compliant, recording bandwidth 640 Mbps, output interface 1 HDMI (up to 4K), 1 VGA, Alarm in/out :16ch in/ 4ch out , 1 X RJ45 ethernet , iOS	0.09%	89.914%

		smartphone support, 8 HDD support , each HDD slot support upto 8 TB HDD, RAID support , complete as per specifications		
2	2.8.5	SITC of IP based Access Controllers with Built in Face recognition cum card reader, Double & single Leaf with 600 LBS holding force, as per approved datasheet.	0.110%	90.024%
2	2.8.6	Providing and fixing Mild steel conduiting, Cat 6 cabling, PVC copper cabling etc. as per specifications	0.120%	90.144%
2	2.8.7	Supply, Installation, Testing & commissioning of Desktop as per approved datasheet including Modular Access Management software	0.078%	90.222%
2	2.8.8	SITC of Core Switch with 1*USB 2.0 port, 24*1/10G SFP+ fiber ports (Data), 1*RS232 Console port(9600,8,N,1), 4*40G/100G QSFP28 fiber ports (Data)1*10/100/1000M RJ45 management port(Data), Forwarding Rate @ 64byte 952Mpps. Operation TEMP/ Humidity -20 to +55°C.	0.480%	90.702%
2	2.8.9	SITC of Rack Mounted Industrial 24 port L2+ Managed switch having 24*10/100/1000Base-T POE ports, 4*100/1000Base-X uplink SFP ports, 1*RS232 Console port. Forwarding Rate @ 64 byte 38.69Mpps .Operation TEMP/ Humidity -40~+85°C.	0.130%	90.832%
2	2.8.10	ON SITC of CAT 6 patch panel, jacks , nut bolts and balance miscellaneous items as per schedule required to complete the systems	0.057%	90.889%
2	2.9.	WIFI, TV, TELEPHONE SYSTEM		90.889%
2	2.9.1	Supply and laying of 4 Pair UTP Cable 23 AWG copper with integral cross-member pair separator (bidirectional tape, strips and others will not be accepted) (Cat-6) standards in PVC conduits as per GFC drawings	0.025%	90.914%
2	2.9.2	SITC of the Microservices based WLAN Architecture. The indoor AP should have radios to support 2.4Ghz and 5 Ghz band in a 4X4:4 Mu-MIMO configuration with support for 802.11 a/b/g/n/ac. The AP should have internal Omni Antennas and should support vBLE and RF optimization. It should also support way finding and asset tracking via Bluetooth. Should support Artificial Intelligence platform, WIPS/WIDS to detect Rogue APs and the facility to terminate connection to the Rogue APs.Plenum rated and support for UL 60950-1 CAN/CSAC22.2 No. 60950-1, FCC Part 15.247, 15.407, 15.107, and 15.109 RSS247 ICES003.	0.080%	90.994%
2	2.9.3	SITC of Appliance Server based customised ITAM for asset inventory management with ability to map physical locations and exact rack elevations for audit and support control. Appliance shall be Intel x86 based device with secure intranet server with Linux Based operating system and relational databases for long term storage. Appliance includes license for 500 units under control.	0.044%	91.038%
2	2.9.4	On SITC of RJ 45 & balance items as required to complete the system	0.004%	91.042%

2	2.10.	AUDIO VISUAL SYSTEM		91.042%
2	2.10.1	SITC of AV System including lighting automation, speaker, amplifier etc. For Meeting Rooms.	0.670%	91.712%
2	2.10.2	SITC of AV System including lighting automation, speaker, amplifier etc. For Board room	0.270%	91.982%
2	2.11.	HVAC - low side works		91.982%
2	2.11.1	On Supplying and fixing of mild steel chilled water piping with 75mm insulation at all floors - 150mm mm dia	0.040%	92.022%
2	2.11.2	On Supplying and fixing of mild steel chilled water piping with 50mm insulation at all floors - 20mm to 125 mm dia	0.170%	92.192%
2	2.11.3	On Supplying and fixing of condensate drain piping and insulation	0.014%	92.206%
2	2.11.4	On Supplying and fixing of all types of valves and strainers at all levels	0.180%	92.386%
2	2.11.5	Providing and fixing of thermostat for dual mode both heating and cooling along with sensor and control cabling. (BMS compatible) Semi Flush-mount room temperature controllers with LCD display, 24V AC Model RDU340 and thermometers as per schedule	0.028%	92.414%
2	2.11.6	SITC of factory fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per GFC drawings and specifications of all thickness at all floors	0.315%	92.729%
2	2.11.7	On Supplying and fixing of site fabricated GSS sheet metal rectangular ducting with supports as per IS 655-2006 complete with neoprene rubber gaskets of all thickness at all floors	0.030%	92.759%
2	2.11.8	On SITC of floor mounted air handling units of various airflows as per schedule & GFC drawings	1.130%	93.889%
2	2.11.9	On SITC of 2 TR (2 working + 1 stand by) 3 no inverter air cooled Hi wall Split air-conditioning unit of BEE 5 star rating consist of outdoor unit, indoor unit wireless remote control complete as per specifications	0.540%	94.429%
2	2.11.10	On SITC of internal AC ducting of PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas, Panel / Board should be CFC/HCFC Free Green Pro & GRIHA Certified, Thickness is 20mm, Density of PIR foam 45 kg/m³, Thermal Conductivity 0.023W/m.K. at 10 degC mean temp, can withstand -35 Deg C to 110 Deg C, complete as per specification for all floors complete	1.140%	95.569%
2	2.11.11	SITC of external PIR' (Polyisocyanurate Rigid) Preinsulated Ducts for AC Areas as per specifications	0.100%	95.669%
2	2.11.12	SITC of electrostatic filter single module - 1000 cfm as per specifications, complete as per schedule	0.081%	95.750%
2	2.11.13	SITC of electrostatic filter single module - 2000 cfm as per specifications, complete as per schedule	0.470%	96.220%

2	2.11.14	On SITC of Pressure independent variable air volume Terminal units 100 to 3000 cfm , suitable for installation in horizontal ducts as per schedule complete at all floors.	0.410%	96.630%
2	2.11.15	On SITC of Heat recovery units of all sizes factory fabricated Double skinned construction with Thermal Break Profile with (0.8mm) pre coated GSS from outside & (0.8mm) GSS on inside with PUF Insulation at all floors as per schedule	1.240%	97.870%
2	2.11.16	On SITC of AHU coil mounted UVGI system of all sizes at all floors	0.260%	98.130%
2	2.11.17	Providing, laying, jointing, testing and commissioning of Grooved Couplings & Grooved Fittings in pipes for Chilled Water and Condenser Water Lines including all accessories at all floors.	0.190%	98.320%
2	2.11.18	SITC of fire dampers in supply air duct/main branch and return air path as and where required of required sizes i/c control wiring - fire damper / actuator as per GFC drawings.	0.130%	98.450%
2	2.11.19	On SITC of powder coated extruded aluminium Supply Air Grills/ exhaust with aluminium volume control dampers / supply / return grills with louvers, return air diffusers as at all floors per specifications.	0.115%	98.565%
2	2.11.20	Providing and fixing of acoustic lining on wall and ceiling of AHU rooms with 25mm thick Rigid Board of Glass wool one side aluminum faced and other side black glass cloth lamination, density 70 to 80 kg/Cu.m at II floors	0.210%	98.775%
2	2.11.21	On SITC of HVAC dedicated VFDs suitable for the 4 KW AHU fan motor capacity with IP 21 complete as per specifications at all floors	0.670%	99.445%
2	2.11.22	On completion of balance items as required to complete the system as pr GFC drawings and schedules at all floors	0.040%	99.485%
2	2.11.23	On SITC of backward curved SISW Centrifugal Cabinet Fan of various cfm's at various locations with flexible connection & gravity louvers at outlet, class-F insulation of IE3 efficiency grade complete as per specifications	0.470%	99.955%
2	2.12.	On supply & fixing of internal signage for fire, lifts, rooms, corridors, lobbies staircases etc. as per GFC drawings	0.045%	100.000%
2		Total	100.000%	
		3 BHK Faculty Residences		
3	3	Completion of 3 BHK Faculty Residences – G+6 floors - (1 Block as per detailed scope of work, technical specification and GFC drawings (95.00% of the Quoted Amount for Item No. 3.0 of Financial Quote Part H) & as per NIT.		
3	3.1.1	Excavation, Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 100% of total no.	10.790%	10.790%
3	3.1.2	Testing of piles - Initial and routine and Integrity	0.140%	10.930%

3	3.1.3	Laying lean concrete below pile caps, raft - 100% area of total area	0.330%	11.260%
3	3.1.4	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -100% Area total	5.340%	16.600%
3	3.1.5	Casting RCC columns, shear walls, lift retaining wall upto bottom of grade slab i/c reinforcement, form work	2.330%	18.930%
3	3.1.6	Filling earth over RCC caps, raft, ground i/c compaction to 95% proctor's density - 100% of total area	0.240%	19.170%
3	3.1.7	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 100% area of total	1.730%	20.900%
3	3.1.8	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to Ground Floor roof slab Level - 100% area	3.750%	24.650%
3	3.1.9	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to First Floor roof slab Level - 100% area	3.750%	28.400%
3	3.1.10	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to second Floor roof slab Level - 100% area	3.750%	32.150%
3	3.1.11	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to third Floor roof slab Level - 100% area	3.750%	35.900%
3	3.1.12	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to fourth Floor roof slab Level - 100% area	3.750%	39.650%
3	3.1.13	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to fifth Floor roof slab Level - 100% area	3.750%	43.400%
3	3.1.14	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to sixth Floor roof slab Level - 100% area	3.750%	47.150%
3	3.1.15	Casting of RCC staircase, column, beam and slab, water tank and all other RCC work at terrace floor - 100% area	1.620%	48.770%
3	3.1.16	Providing Antitermite treatment to all blocks	0.110%	48.880%
3	3.1.17	Providing steel work for various misc. works with primer and painting etc. complete at all floors.	0.100%	48.980%
3	3.1.18	Completion of all Masonry walls including RCC lintels, bands, mullions, stub columns with reinforcement and form work etc.		48.980%
3	3.1.19	All Masonry works for Ground Floor Level	0.960%	49.940%
3	3.1.20	All Masonry works for First Floor Level	0.960%	50.900%
3	3.1.21	All Masonry works for second Floor Level	0.960%	51.860%
3	3.1.22	All Masonry works for third Floor Level	0.960%	52.820%
3	3.1.23	All Masonry works for fourth Floor Level	0.960%	53.780%
3	3.1.24	All Masonry works for fifth Floor Level	0.960%	54.740%
3	3.1.25	All Masonry works for sixth Floor Level	0.960%	55.700%

3	3.1.26	On completion of Masonry work up to terrace slab, Mumty, lift Machine room & terrace parapets.	0.100%	55.800%
3	3.1.27	Completion of internal plaster work up to Ground & First Floor Level	0.570%	56.370%
3	3.1.28	Completion of internal plaster work up to Second & Third Floor Level	0.570%	56.940%
3	3.1.29	Completion of internal plaster work up to Fourth & fifth Floor Level	0.570%	57.510%
3	3.1.30	Completion of internal plaster work at sixth Floor Level, terrace floor, Mumty, lift Machine room	0.570%	58.080%
3	3.1.31	External wall Finishing with waterproof plaster from ground to parapet, Mumty top level on all sides	2.070%	60.150%
3	3.1.32	External wall exterior grade texture paint i/c primer on all sides as per approved sample	0.730%	60.880%
3	3.1.33	Completion of granite & kota stone / tiles flooring, PCC floor including skirting, PCC required in sunken areas and below tile flooring to match levels at all levels for all floors as per GFC drawings & finishing schedule	4.200%	65.080%
3	3.1.34	Completion of Waterproofing works of Terraces, sunken areas of toilet, kitchen, balconies i/c mumty roof waterproofing with brick bat coba treatment, concrete golas, khurras at all blocks as per specifications at all floors	1.150%	66.230%
3	3.1.35	Completion of door frames with Powder coated aluminium extruded profile size section 100mm x 55mm x 2mm thick fixed with fasteners including Natural aluminium rectangular tube subframe for doors, windows, ventilators, glazing's at all floors	1.530%	67.760%
3	3.1.36	Completion of all ceramic & vitrified tile dado, granite dado, including window sills and jambs etc. in toilets, kitchen, pantry at all floors and Polished granite dado, bands, in lift lobbies, corridors etc. at all floors	1.130%	68.890%
3	3.1.37	Supplying, fabricating and installing powder coated windows / ventilator shutters with SS stays, openable shutters at all floors without glass	1.720%	70.610%
3	3.1.38	On completion of all types of False ceiling works as per finishing schedule / GFC drawing at all levels complete	0.270%	70.880%
3	3.1.39	Supply and installation of mild steel frame work for aluminium louvers, WPC screens etc. i/c primer and anti rust painting.	0.050%	70.930%
3	3.1.40	Supply and installation of wood composite panels / screens / jalis as per elevations, drawings at all levels.	0.240%	71.170%
3	3.1.41	On completion of internal / external white cement based putty, anti bacterial plastic emulsion painting, oil bound distempering, white washing, enamel painting and finishing work at all floors as per finishing schedule & GFC drawings	1.420%	72.590%
3	3.1.42	On completion of fire doors, shaft doors, Supply and installation of 120 minutes fire rated door frame and shutters with or without fire rated vision panel glass, SS butt hinges, sealing of joints of frame and walls and SS fire rated	0.370%	72.960%

		hardware for fire and shaft doors like panic bar, trim, door closers, tower bolt, coordinator		
3	3.1.43	On completion of frame less glass doors, glass paneling in door, windows, ventilators and mirrors etc. at all floors as per GFC drawings & specifications.	0.680%	73.640%
3	3.1.44	On fixing of laminated flush door shutters with hinges to door frames at all floors	0.850%	74.490%
3	3.1.45	On completion of stainless steel 304 grade railing, glass railings with stainless steel supports for staircases, balconies, terraces, double height areas, lobbies etc. at all locations as per GFC drawings.	1.950%	76.440%
3	3.1.46	On completion of All type of door, windows, ventilators hardware like stainless steel 304 grade handles, tower bolts, mortice locks, cylinders, door stoppers, door buffers, SS kick plates, push plates, mop plates, floor springs, SS sign plates, SS door handles , Door closers of all types at all floors.	0.230%	76.670%
3	3.1.47	On completion of various small items not mentioned above but shown in drawings / required for completion	0.100%	76.770%
3	3.2.	Internal Water supply, Sanitary Installation and Drainage work up to first manhole including preparation of shop drawings		76.770%
3	3.2.1	Completion of Internal grid of water supply CPVC concealed and exposed piping 20mm to 50mm dia for all floor levels i/c thermal insulation complete	1.000%	77.770%
3	3.2.4	Completion of exposed CPVC SCH-40 piping 50mm to 100mm dia up to Terrace Floor level and terrace water tanks	0.060%	77.830%
3	3.2.5	Providing and fixing of Single phase electrical actuator operated wafer type rubber lined butterfly valve with by pass arrangement including level controller, 3 nos. normal butterfly valves, necessary control and Power cables and control panel installed on OH tank filling line near the tanks complete, Providing and fixing threaded end brass digital water meter	0.080%	77.910%
3	3.2.6	Completion of sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, with all necessary fittings from 40mm to 160mm dia at all locations, levels complete	1.110%	79.020%
3	3.2.8	On fixing of forged brass ball valves , butter fly valves	0.120%	79.140%
3	3.2.9	On completion of uPVC pipes 110mm / 160mm OD pipe i/c fittings complete	0.330%	79.470%
3	3.2.10	SITC of fixed speed Hydropneumatic system, Set of Two Pump (1 Working + Standby), Capacity - 1.5 LPS, H.P. - 1.0 HP (Approx.), mounted on a common base plate comprising of vertical inline multistage pumping set with Stainless steel-304 body, Stainless steel-304 impeller, Stainless steel-304 casing, shaft of Stainless steel-316 and C.I. base & head with mechanical seal, shaft directly coupled to a TEFC induction motor suitable for 400/440 volts, 3 phase, 50 cycles AC supply with 150 mm dia pressure gauge with gunmetal isolation cock, vibration eliminating pads under foundation, dry	0.160%	79.630%

		running Protection, motor control centre, necessary power and control cabling from MCC to pumps , complete system		
3	3.2.12	Providing and fixing Stainless Steel A ISI 304 (18/8) kitchen sink with drain board 510x1040 mm, bowl depth 200mm, as per IS 13983 with C.I. brackets and stainless steel plug 40 mm complete	0.120%	79.750%
3	3.2.13	On supply and fixing of white vitreous china wash basin with special fabricated brackets painted white, faucets as required, 32 mm C.P. brass waste.32 mm C.P. brass bottle trap & pipe to wall with rubber adopter for waste connection and C.P. brass wall flange	0.230%	79.980%
3	3.2.15	Supply and fixing of water supply fittings and fixtures - CP mixer, faucet, bib cock, showers, health faucet etc. all items as per schedule, complete	1.150%	81.130%
3	3.2.16	Providing and fixing vertical storage type hot water heater, Capacity 25 Litres Model 25 GV fixed to wall with anchor bolts & nuts, 15mm CP brass angle stop cock and 15mm CP brass non-return valve complete including making connections with 15mm dia CP connecting pipes on inlet and outlet, suitable length of power cable and 15 amps plug all units.	0.740%	81.870%
3	3.2.17	Supply and fixing of wall hung WC with cover - 100% of total nos.	0.220%	82.090%
3	3.2.18	On completion of all items not mentioned above but shown in GFC drawings / required to complete work	0.010%	82.100%
3	3.2.19	On completion of entire work and testing		82.100%
3	3.3.	Internal Electrical works including MDB's, Light Fixture, fans		82.100%
3	3.3.1	Laying of Conduit and junction boxes for light / ceiling fan / exhaust fan points, light & power plugs for all floors in recess complete	0.320%	82.420%
3	3.3.2	Drawing PVC insulated copper wires 1.5 sqmm in conduits for light / ceiling fan / exhaust fan points, call bell points for all floors complete	0.320%	82.740%
3	3.3.3	Fixing of modular switches & connections at all floors for light / ceiling fan / exhaust fan points, call bell points, complete for all floors	0.320%	83.060%
3	3.3.4	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 1 No. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for all floors, complete	2.030%	85.090%
3	3.3.5	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for all floors complete	2.170%	87.260%
3	3.3.6	Wiring for circuit/ submain wiring along with earth wire with various sizes 1.5 sqmm to 16 sqmm of FRLS PVC insulated copper conductor, single core cable at all floors in MS conduits complete	4.070%	91.330%

3	3.3.7	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections and 6 pin 5/6 A & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. at all floors	0.680%	92.010%
3	3.3.8	Supplying and fixing of MV distribution boards - single pole, three pole with all types of MCB, DP switch, RCCB etc. for all floors, complete	0.420%	92.430%
3	3.3.9	Supplying and fixing of Main distribution board - for light & power, ventilation, lifts, etc. for tower complete	0.750%	93.180%
3	3.3.10	On SITC of LED Surface / concealed mounted Down lighters as per GFC at all floors	0.210%	93.390%
3	3.3.11	On SITC of LED bracket light / LED Batten in 18 W / LED Bulk head light , at all floors as per schedule	0.190%	93.580%
3	3.3.12	On SITC of ceiling and wall fans at all floors	0.300%	93.880%
3	3.3.13	On completion of all balance miscellaneous activities related to electrical works i/c lighting conductors not mentioned above at required locations.	0.300%	94.180%
3	3.3.14	On SITC of IP CCTV & Telephone system as per schedule, GFC drawings	0.400%	94.580%
3	3.3.15	On SITC of fire detection / alarm system for all floors complete as per GFC drawings	0.550%	95.130%
3	3.4.	ON SITC of lifts		95.130%
3	3.4.1	On supply of 100% lifts for passengers for tower	2.280%	97.410%
3	3.4.2	On installation of 100% lifts	0.320%	97.730%
3	3.4.3	On testing, commissioning of all lifts	0.320%	98.050%
3	3.4.4	On getting certificate & license of Local lift authority	0.320%	98.370%
3	3.5.	Fire Fighting system		98.370%
3	3.5.1	On completion of fire fighting system including MS piping, pump , electrical panel, vessel, valves etc. complete	1.360%	99.730%
3	3.5.2	Providing and fixing carbon-di-oxide type fire extinguishers 4.5 kg capacity and Providing and fixing ABC Powder type fire extinguishers 6 kg capacity	0.220%	99.950%
3	3.6	On completion of internal signage - fire and general at all floors	0.050%	100.000%
3		Total	100.00%	
		2 BHK Faculty Residences		
4		Completion of 2 BHK Faculty Residences – G+6 floors - (1 Block) as per detailed scope of work, technical specification and GFC drawings		

		(95.00% of the Quoted Amount for Item No. 4.0 of Financial Quote Part H) & as per NIT.		
4	4.1.1	Excavation, Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 100% of total no.	8.310%	8.310%
4	4.1.1	Testing of piles - Initial and routine and Integrity	0.200%	8.510%
4	4.1.2	Laying lean concrete below pile caps, raft - 100% area of total area	0.420%	8.930%
4	4.1.3	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -100% Area total	6.000%	14.930%
4	4.1.4	Casting RCC columns, shear walls, lift retaining wall upto bottom of grade slab i/c reinforcement, form work	4.180%	19.110%
4	4.1.5	Filling earth over RCC caps, raft, ground i/c compaction to 95% proctor's density - 100% of total area	0.450%	19.560%
4	4.1.6	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 100% area of total	2.300%	21.860%
4	4.1.7	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to Ground Floor roof slab Level - 100% area	3.610%	25.470%
4	4.1.8	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to First Floor roof slab Level - 100% area	3.610%	29.080%
4	4.1.9	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to second Floor roof slab Level - 100% area	3.610%	32.690%
4	4.1.10	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to third Floor roof slab Level - 100% area	3.610%	36.300%
4	4.1.11	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to fourth Floor roof slab Level - 100% area	3.610%	39.910%
4	4.1.12	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to fifth Floor roof slab Level - 100% area	3.620%	43.530%
4	4.1.13	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to sixth Floor roof slab Level - 100% area	3.620%	47.150%
4	4.1.14	Casting of RCC staircase, column, beam and slab, water tank and all other RCC work at terrace floor - 100% area	1.540%	48.690%
4	4.1.15	Providing Antitermite treatment to all blocks	0.110%	48.800%
4	4.1.16	Providing steel work for various misc. works with primer and painting etc. complete at all floors.	0.100%	48.900%
4	4.1.17	Completion of all Masonry walls including RCC lintels, bands, mullions, stub columns with reinforcement and form work etc.		48.900%
4	4.1.18	All Masonry works for Ground Floor Level	0.790%	49.690%
4	4.1.19	All Masonry works for First Floor Level	0.790%	50.480%
4	4.1.20	All Masonry works for second Floor Level	0.790%	51.270%
4	4.1.21	All Masonry works for third Floor Level	0.790%	52.060%

4	4.1.22	All Masonry works for fourth Floor Level	0.790%	52.850%
4	4.1.23	All Masonry works for fifth Floor Level	0.790%	53.640%
4	4.1.24	All Masonry works for sixth Floor Level	0.790%	54.430%
4	4.1.25	On completion of Masonry work up to terrace slab, Mumty, lift Machine room & terrace parapets.	0.100%	54.530%
4	4.1.26	Completion of internal plaster work up to Ground & First Floor Level	0.620%	55.150%
4	4.1.27	Completion of internal plaster work up to Second & Third Floor Level	0.620%	55.770%
4	4.1.28	Completion of internal plaster work up to Fourth & fifth Floor Level	0.620%	56.390%
4	4.1.29	Completion of internal plaster work at sixth Floor Level, terrace floor, Mumty, lift Machine room	0.620%	57.010%
4	4.1.30	External wall Finishing with waterproof plaster from ground to parapet, Mumty top level on all sides	1.720%	58.730%
4	4.1.31	External wall exterior grade texture paint i/c primer on all sides as per approved sample	0.760%	59.490%
4	4.1.32	Completion of granite & kota stone / tiles flooring, PCC floor including skirting, PCC required in sunken areas and below tile flooring to match levels at all levels for all floors as per GFC drawings & finishing schedule	3.630%	63.120%
4	4.1.33	Completion of Waterproofing works of Terraces, sunken areas of toilet, kitchen, balconies i/c mumty roof waterproofing with brick bat coba treatment, concrete golas, khurras at all blocks as per specifications at all floors	1.440%	64.560%
4	4.1.34	Completion of door frames with Powder coated aluminium extruded profile size section 100mm x 55mm x 2mm thick fixed with fasteners including Natural aluminium rectangular tube subframe for doors, windows, ventilators, glazing's at all floors	1.450%	66.010%
4	4.1.35	Completion of all ceramic & vitrified tile dado, granite dado, including window sills and jambs etc. in toilets, kitchen, pantry at all floors and Polished granite dado, bands, in lift lobbies, corridors etc. at all floors	1.820%	67.830%
4	4.1.36	Supplying, fabricating and installing powder coated windows / ventilator shutters with SS stays, openable shutters at all floors without glass	1.300%	69.130%
4	4.1.37	On completion of all types of False ceiling works as per finishing schedule / GFC drawing at all levels complete	0.270%	69.400%
4	4.1.38	Supply and installation of mild steel frame work for aluminium louvers, WPC screens etc. i/c primer and anti rust painting.	0.120%	69.520%
4	4.1.39	Supply and installation of wood composite panels / screens / jalis as per elevations, drawings at all levels.	0.750%	70.270%
4	4.1.40	On completion of internal / external white cement based putty, anti bacterial plastic emulsion painting, oil bound distempering, white washing, enamel painting and finishing work at	1.400%	71.670%

		all floors as per finishing schedule & GFC drawings		
4	4.1.41	On completion of fire doors, shaft doors, Supply and installation of 120 minutes fire rated door frame and shutters with or without fire rated vision panel glass, SS butt hinges, sealing of joints of frame and walls and SS fire rated hardware for fire and shaft doors like panic bar, trim, door closers, tower bolt, coordinator	0.500%	72.170%
4	4.1.42	On completion of frame less glass doors, glass paneling in door, windows, ventilators and mirrors etc. at all floors as per GFC drawings & specifications.	0.640%	72.810%
4	4.1.43	On fixing of laminated flush door shutters with hinges to door frames at all floors	0.780%	73.590%
4	4.1.44	On completion of stainless steel 304 grade railing, glass railings with stainless steel supports for staircases, balconies, terraces, double height areas, lobbies etc. at all locations as per GFC drawings.	1.730%	75.320%
4	4.1.45	On completion of All type of door, windows, ventilators hardware like stainless steel 304 grade handles, tower bolts, mortice locks, cylinders, door stoppers, door buffers, SS kick plates, push plates, mop plates, floor springs, SS sign plates, SS door handles , Door closers of all types at all floors.	0.230%	75.550%
4	4.1.46	On completion of various small items not mentioned above but shown in drawings / required for completion	0.100%	75.650%
4	4.2.	Internal Water supply, Sanitary Installation and Drainage work up to first manhole including preparation of shop drawings		75.650%
4	4.2.1	Completion of Internal grid of water supply CPVC concealed and exposed piping 20mm to 50mm dia for all floor levels i/c thermal insulation complete	1.030%	76.680%
4	4.2.2	Completion of exposed CPVC SCH-40 piping 50mm to 100mm dia up to Terrace Floor level and terrace water tanks	0.060%	76.740%
4	4.2.3	Providing and fixing of Single phase electrical actuator operated wafer type rubber lined butterfly valve with by pass arrangement including level controller, 3 nos. normal butterfly valves, necessary control and Power cables and control panel installed on OH tank filling line near the tanks complete, Providing and fixing threaded end brass digital water meter	0.060%	76.800%
4	4.2.4	Completion of sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, with all necessary fittings from 40mm to 160mm dia at all locations, levels complete	1.460%	78.260%
4	4.2.5	On fixing of forged brass ball valves , butter fly valves	0.120%	78.380%
4	4.2.6	On completion of uPVC pipes 110mm / 160mm OD pipe i/c fittings complete	0.430%	78.810%
4	4.2.7	SITC of fixed speed Hydropneumatic system, Set of Two Pump (1 Working + Standby), Capacity - 1.5 LPS, H.P. - 1.0 HP (Approx.), mounted on a common base plate comprising of vertical inline multistage pumping set with Stainless steel-304 body, Stainless steel-304	0.140%	78.950%

		impeller, Stainless steel-304 casing, shaft of Stainless steel-316 and C.I. base & head with mechanical seal, shaft directly coupled to a TEFC induction motor suitable for 400/440 volts, 3 phase, 50 cycles AC supply with 150 mm dia pressure gauge with gunmetal isolation cock, vibration eliminating pads under foundation, dry running Protection, motor control centre, necessary power and control cabling from MCC to pumps , complete system		
4	4.2.8	Providing and fixing Stainless Steel A ISI 304 (18/8) kitchen sink with drain board 510x1040 mm, bowl depth 200mm, as per IS 13983 with C.I. brackets and stainless steel plug 40 mm complete	0.130%	79.080%
4	4.2.9	On supply and fixing of white vitreous china wash basin with special fabricated brackets painted white, faucets as required, 32 mm C.P. brass waste.32 mm C.P. brass bottle trap & pipe to wall with rubber adopter for waste connection and C.P. brass wall flange	0.250%	79.330%
4	4.2.10	Supply and fixing of water supply fittings and fixtures - CP mixer, faucet, bib cock, showers, health faucet etc. all items as per schedule, complete	1.280%	80.610%
4	4.2.11	Providing and fixing vertical storage type hot water heater, Capacity 25 Litres Model 25 GV fixed to wall with anchor bolts & nuts, 15mm CP brass angle stop cock and 15mm CP brass non-return valve complete including making connections with 15mm dia CP connecting pipes on inlet and outlet, suitable length of power cable and 15 amps plug all units.	0.840%	81.450%
4	4.2.12	Supply and fixing of wall hung WC with cover - 100% of total nos.	0.490%	81.940%
4	4.2.13	On completion of all items not mentioned above but shown in GFC drawings / required to complete work	0.010%	81.950%
4	4.2.14	On completion of entire work and testing	0.010%	81.960%
4	4.3.	Internal Electrical works including MDB's, Light Fixture, fans		81.960%
4	4.3.1	Laying of Conduit and junction boxes for light / ceiling fan / exhaust fan points, light & power plugs for all floors in recess complete	0.610%	82.570%
4	4.3.2	Drawing PVC insulated copper wires 1.5 sqmm in conduits for light / ceiling fan / exhaust fan points, call bell points for all floors complete	0.610%	83.180%
4	4.3.3	Fixing of modular switches & connections at all floors for light / ceiling fan / exhaust fan points, call bell points, complete for all floors	0.610%	83.790%
4	4.3.4	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 1 No. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for all floors, complete	0.180%	83.970%
4	4.3.5	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for	0.470%	84.440%

		all floors complete		
4	4.3.6	Wiring for circuit/ submain wiring along with earth wire with various sizes 1.5 sqmm to 16 sqmm of FRLS PVC insulated copper conductor, single core cable at all floors in MS conduits complete	5.170%	89.610%
4	4.3.7	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections and 6 pin 5/6 A & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. at all floors	1.280%	90.890%
4	4.3.8	Supplying and fixing of MV distribution boards - single pole, three pole with all types of MCB, DP switch, RCCB etc. for all floors, complete	0.790%	91.680%
4	4.3.9	Supplying and fixing of Main distribution board - for light & power, ventilation, lifts, etc. for tower complete	1.690%	93.370%
4	4.3.10	On SITC of LED Surface / concealed mounted Down lighters as per GFC at all floors	0.360%	93.730%
4	4.3.11	On SITC of LED bracket light / LED Batten in 18 W / LED Bulk head light , at all floors as per schedule	0.340%	94.070%
4	4.3.12	On SITC of ceiling and wall fans at all floors	0.560%	94.630%
4	4.3.13	On completion of all balance miscellaneous activities related to electrical works i/c lighting conductors not mentioned above at required locations.	0.250%	94.880%
4	4.3.14	On SITC of IP CCTV & Telephone system as per schedule, GFC drawings	0.370%	95.250%
4	4.3.15	On SITC of fire detection / alarm system for all floors complete as per GFC drawings	0.720%	95.970%
4	4.4.	ON SITC of lifts		95.970%
4	4.4.1	On supply of 100% lifts for passengers for tower	1.890%	97.860%
4	4.4.2	On installation of 100% lifts	0.270%	98.130%
4	4.4.3	On testing, commissioning of all lifts	0.270%	98.400%
4	4.4.4	On getting certificate & license of Local lift authority	0.270%	98.670%
4	4.5.	Fire Fighting system		98.670%
4	4.5.1	On completion of fire fighting system including MS piping, pump , electrical panel, vessel, valves etc. complete	1.090%	99.760%
4	4.5.2	Providing and fixing carbon-di-oxide type fire extinguishers 4.5 kg capacity and Providing and fixing ABC Powder type fire extinguishers 6 kg capacity	0.190%	99.950%
4	4.6	On completion of internal signage - fire and general at all floors	0.050%	100.000%
4		Total	100.00%	

		Nursing Hostel		
5	5	Completion of Nursing hostel – G+9 floors - (1 Block) as per detailed scope of work, technical specification and GFC drawings (95.00% of the Quoted Amount for Item No. 5.0 of Financial Quote Part H) & as per NIT.		
5	5.1.1	Excavation, Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 100% of total no.	4.940%	4.940%
5	5.1.2	Testing of piles - Initial and routine and Integrity	0.170%	5.110%
5	5.1.3	Laying lean concrete below pile caps, raft - 100% area of total area	0.310%	5.420%
5	5.1.4	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -100% Area total	3.500%	8.920%
5	5.1.5	Casting RCC columns, shear walls, lift retaining wall upto bottom of grade slab i/c reinforcement, form work	3.590%	12.510%
5	5.1.6	Filling earth over RCC caps, raft, ground i/c compaction to 95% proctor's density - 100% of total area	0.380%	12.890%
5	5.1.7	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 100% area of total	2.020%	14.910%
5	5.1.8	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to Ground Floor roof slab Level - 100% area	2.670%	17.580%
5	5.1.9	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to First Floor roof slab Level - 100% area	2.670%	20.250%
5	5.1.10	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to second Floor roof slab Level - 100% area	2.670%	22.920%
5	5.1.11	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to third Floor roof slab Level - 100% area	2.670%	25.590%
5	5.1.12	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to fourth Floor roof slab Level - 100% area	2.670%	28.260%
5	5.1.13	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to fifth Floor roof slab Level - 100% area	2.700%	30.960%
5	5.1.14	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to sixth Floor roof slab Level - 100% area	2.700%	33.660%
5	5.1.15	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to seventh Floor roof slab Level - 100% area	2.700%	36.360%
5	5.1.16	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to eighth Floor roof slab Level - 100% area	2.700%	39.060%
5	5.1.17	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to ninth Floor roof slab Level - 100% area	2.700%	41.760%
5	5.1.18	Casting of RCC staircase, column, beam and slab, water tank and all other RCC work at terrace floor - 100% area	1.700%	43.460%

5	5.1.19	Providing Antitermite treatment to all blocks	0.100%	43.560%
5	5.1.20	Providing steel work for various misc. works with primer and painting etc. complete at all floors.	0.100%	43.660%
5	5.1.21	Completion of all Masonry walls including RCC lintels, bands, mullions, stub columns with reinforcement and form work etc.		43.660%
5	5.1.22	All Masonry works for Ground Floor Level	0.650%	44.310%
5	5.1.23	All Masonry works for First Floor Level	0.650%	44.960%
5	5.1.24	All Masonry works for second Floor Level	0.650%	45.610%
5	5.1.25	All Masonry works for third Floor Level	0.650%	46.260%
5	5.1.26	All Masonry works for fourth Floor Level	0.650%	46.910%
5	5.1.27	All Masonry works for fifth Floor Level	0.650%	47.560%
5	5.1.28	All Masonry works for sixth Floor Level	0.650%	48.210%
5	5.1.29	All Masonry works for seventh Floor Level	0.650%	48.860%
5	5.1.30	All Masonry works for eight Floor Level	0.650%	49.510%
5	5.1.31	All Masonry works for ninth Floor Level	0.650%	50.160%
5	5.1.32	On completion of Masonry work up to terrace slab, Mumty, lift Machine room & terrace parapets.	0.040%	50.200%
5	5.1.33	Completion of internal plaster work up to Ground & First Floor Level	0.310%	50.510%
5	5.1.34	Completion of internal plaster work up to Second & Third Floor Level	0.310%	50.820%
5	5.1.35	Completion of internal plaster work up to Fourth & fifth Floor Level	0.310%	51.130%
5	5.1.36	Completion of internal plaster work up to sixth & seventh Floor Level	0.310%	51.440%
5	5.1.37	Completion of internal plaster work up to eighth & ninth Floor Level	0.310%	51.750%
5	5.1.38	Completion of internal plaster work at sixth Floor Level, terrace floor, Mumty, lift Machine room	0.030%	51.780%
5	5.1.39	External wall Finishing with waterproof plaster from ground to parapet, Mumty top level on all sides	1.260%	53.040%
5	5.1.40	External wall exterior grade texture paint i/c primer on all sides as per approved sample	0.760%	53.800%
5	5.1.41	Completion of granite & kota stone / tiles flooring, PCC floor including skirting, PCC required in sunken areas and below tile flooring to match levels at all levels for all floors as per GFC drawings & finishing schedule	5.200%	59.000%
5	5.1.42	Completion of Waterproofing works of Terraces, sunken areas of toilet, kitchen, balconies i/c mumty roof waterproofing with brick bat coba	2.000%	61.000%

		treatment, concrete golas, khurras at all blocks as per specifications at all floors		
5	5.1.43	Completion of door frames with Powder coated aluminium extruded profile size section 100mm x 55mm x 2mm thick fixed with fasteners including Natural aluminium rectangular tube subframe for doors, windows, ventilators, glazing's at all floors	1.520%	62.520%
5	5.1.44	Completion of all ceramic & vitrified tile dado, granite dado, including window sills and jambs etc. in toilets, kitchen, pantry at all floors and Polished granite dado, bands, in lift lobbies, corridors etc. at all floors	1.500%	64.020%
5	5.1.45	Supplying, fabricating and installing powder coated windows / ventilator shutters with SS stays, openable shutters at all floors without glass	0.450%	64.470%
5	5.1.46	On completion of all types of False ceiling works as per finishing schedule / GFC drawing at all levels complete	1.320%	65.790%
5	5.1.47	Supply and installation of mild steel frame work for aluminium louvers, WPC screens etc. i/c primer and anti rust painting.	0.050%	65.840%
5	5.1.48	Supply and installation of wood composite panels / screens / jalis as per elevations, drawings at all levels.	0.800%	66.640%
5	5.1.49	On completion of internal / external white cement based putty, anti bacterial plastic emulsion painting, oil bound distempering, white washing, enamel painting and finishing work at all floors as per finishing schedule & GFC drawings	1.400%	68.040%
5	5.1.50	On completion of fire doors, shaft doors, Supply and installation of 120 minutes fire rated door frame and shutters with or without fire rated vision panel glass, SS butt hinges, sealing of joints of frame and walls and SS fire rated hardware for fire and shaft doors like panic bar, trim, door closers, tower bolt, coordinator	1.060%	69.100%
5	5.1.51	On completion of frame less glass doors, glass paneling in door, windows, ventilators and mirrors etc. at all floors as per GFC drawings & specifications.	0.410%	69.510%
5	5.1.52	On fixing of laminated flush door shutters with hinges to door frames at all floors	1.570%	71.080%
5	5.1.53	On completion of stainless steel 304 grade railing, glass railings with stainless steel supports for staircases, balconies, terraces, double height areas, lobbies etc. at all locations as per GFC drawings.	3.150%	74.230%
5	5.1.54	On completion of All type of door, windows, ventilators hardware like stainless steel 304 grade handles, tower bolts, mortice locks, cylinders, door stoppers, door buffers, SS kick plates, push plates, mop plates, floor springs, SS sign plates, SS door handles , Door closers of all types at all floors.	0.300%	74.530%
5	5.1.55	On completion of Modular toilet cubicles as per GFC drawings	2.470%	77.000%
5	5.1.56	On completion of various small items not mentioned above but shown in drawings / required for completion	0.020%	77.020%

5	5.2.	Internal Water supply, Sanitary Installation and Drainage work up to first manhole including preparation of shop drawings		77.020%
5	5.2.1	Completion of Internal grid of water supply CPVC concealed and exposed piping 20mm to 50mm dia for all floor levels i/c thermal insulation complete	1.040%	78.060%
5	5.2.2	Completion of exposed CPVC SCH-40 piping 50mm to 100mm dia up to Terrace Floor level and terrace water tanks	0.020%	78.080%
5	5.2.3	Providing and fixing of Single phase electrical actuator operated wafer type rubber lined butterfly valve with by pass arrangement including level controller, 3 nos. normal butter fly valves, necessary control and Power cables and control panel installed on OH tank filling line near the tanks complete, Providing and fixing threaded end brass digital water meter	0.060%	78.140%
5	5.2.4	Completion of sound insulated Polypropylene piping system with 3 layer pipe, colour, push-fit type, with all necessary fittings from 40mm to 160mm dia at all locations, levels complete	1.090%	79.230%
5	5.2.5	On fixing of forged brass ball valves , butter fly valves	0.140%	79.370%
5	5.2.6	On completion of uPVC pipes 110mm / 160mm OD pipe i/c fittings complete	0.740%	80.110%
5	5.2.7	SITC of fixed speed Hydropneumatic system, Set of Two Pump (1 Working + Standby), Capacity - 2.0 LPS, H.P. - 1.5HP (Approx.), mounted on a common base plate comprising of vertical inline multistage pumping set with Stainless steel-304 body, Stainless steel-304 impeller, Stainless steel-304 casing, shaft of Stainless steel-316 and C.I. base & head with mechanical seal, shaft directly coupled to a TEFC induction motor suitable for 400/440 volts, 3 phase, 50 cycles AC supply with 150 mm dia pressure gauge with gunmetal isolation cock, vibration eliminating pads under foundation, dry running Protection, motor control centre, necessary power and control cabling from MCC to pumps , complete system	0.160%	80.270%
5	5.2.8	Providing and fixing Stainless Steel A ISI 304 (18/8) kitchen sink with drain board 510x1040 mm, bowl depth 200mm, as per IS 13983 with C.I. brackets and stainless steel plug 40 mm complete	0.010%	80.280%
5	5.2.9	On supply and fixing of white vitreous china wash basin with special fabricated brackets painted white, faucets as required, 32 mm C.P. brass waste.32 mm C.P. brass bottle trap & pipe to wall with rubber adopter for waste connection and C.P. brass wall flange	0.250%	80.530%
5	5.2.10	Supply and fixing of water supply fittings and fixtures - CP mixer, faucet, bib cock, showers, health faucet etc. all items as per schedule, complete	0.820%	81.350%
5	5.2.11	SITC of Micro Processor Controlled air cooled Heat pump delivering actual capacity, Nominal Input Power & Output Heating capacity , complete system as per specifications- 3nos.	0.470%	81.820%

5	5.2.12	SITC of SS 316 horizontal hot water storage tank with 4 mm thickness suitable for minimum 5 Kg /Sqm working pressure, 1000 & 2500 litres capacity - 1 no each	1.100%	82.920%
5	5.2.13	SITC of Hot Water circulation Pumps in Heat pump and tank. (For 5 KW Heat Pump & 19.8 KW) and return pump	0.230%	83.150%
5	5.2.14	Solar Water Heating System : SITC of package type solar water heating system of capacity 300 ltrs - 2 no as per specifications	0.360%	83.510%
5	5.2.15	Providing and fixing hand dryers	0.290%	83.800%
5	5.2.16	Supply and fixing of wall hung WC with cover - 100% of total nos.	0.380%	84.180%
5	5.2.17	On completion of all items not mentioned above but shown in GFC drawings / required to complete work	0.010%	84.190%
5	5.2.18	On completion of entire work and testing	0.010%	84.200%
5	5.3.	Internal Electrical works including MDB's, Light Fixture, fans		84.200%
5	5.3.1	Laying of Conduit and junction boxes for light / ceiling fan / exhaust fan points, light & power plugs for all floors in recess complete	0.250%	84.450%
5	5.3.2	Drawing PVC insulated copper wires 1.5 sqmm in conduits for light / ceiling fan / exhaust fan points, call bell points for all floors complete	0.250%	84.700%
5	5.3.3	Fixing of modular switches & connections at all floors for light / ceiling fan / exhaust fan points, call bell points, complete for all floors	0.250%	84.950%
5	5.3.4	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 1 No. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for all floors, complete	0.770%	85.720%
5	5.3.5	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit along with 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing for all floors complete	0.540%	86.260%
5	5.3.6	Wiring for circuit/ submain wiring along with earth wire with various sizes 1.5 sqmm to 16 sqmm of FRLS PVC insulated copper conductor, single core cable at all floors in MS conduits complete	2.420%	88.680%
5	5.3.7	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections and 6 pin 5/6 A & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. at all floors	0.120%	88.800%
5	5.3.8	Supplying and fixing of MV distribution boards - single pole, three pole with all types of MCB, DP switch, RCCB etc. for all floors, complete	0.330%	89.130%
5	5.3.9	Supplying and fixing of Main distribution board - for light & power, ventilation, lifts, etc. for tower complete	1.850%	90.980%

5	5.3.10	On SITC of LED Surface / concealed mounted Down lighters as per GFC at all floors	0.280%	91.260%
5	5.3.11	On SITC of LED bracket light / LED Batten in 18 W / LED Bulk head light , at all floors as per schedule	0.510%	91.770%
5	5.3.12	On SITC of ceiling and wall fans at all floors	0.130%	91.900%
5	5.3.13	On completion of all balance miscellaneous activities related to electrical works i/c lighting conductors not mentioned above at required locations.	0.220%	92.120%
5	5.4.	On SITC of IP CCTV & Telephone system as per schedule, GFC drawings	1.260%	93.380%
5	5.5.	On SITC of fire detection / alarm system for all floors complete as per GFC drawings	0.420%	93.800%
5	5.6.	Structured cabling (pasive), Data cabling	0.380%	94.180%
5	5.7.	ON SITC of lifts		94.180%
5	5.7.1	On supply of 100% lifts for passengers for tower	2.880%	97.060%
5	5.7.2	On installation of 100% lifts	0.410%	97.470%
5	5.7.3	On testing, commissioning of all lifts	0.410%	97.880%
5	5.7.4	On getting certificate & license of Local lift authority	0.410%	98.290%
5	5.8.	Fire Fighting system		98.290%
5	5.8.1	On completion of fire fighting system including MS piping, pump , electrical panel, vessel, valves etc. complete	1.450%	99.740%
5	5.8.2	Providing and fixing carbon-di-oxide type fire extinguishers 4.5 kg capacity and Providing and fixing ABC Powder type fire extinguishers 6 kg capacity	0.260%	100.000%
				94.180%
5		Total	100.00%	
6		Resident Hostel cum Guest House Building		
6	6	Completion of Residents Hostel Cum Guest House- G+7 floors - (1 Block) as per detailed scope of work, technical specification and GFC drawings. (95.00% of the Quoted Amount for Item No. 6.0 of Financial Quote Part H) & as per NIT		
6	6.1.1	Excavation, Boring piles, providing reinforcement, cast-in-situ reinforced cement concrete - 100% of total no.	5.080%	5.080%
6	6.1.2	Testing of piles - Initial and routine and Integrity	0.170%	5.250%
6	6.1.3	Laying lean concrete below pile caps, raft - 100% area of total area	0.310%	5.560%

6	6.1.4	Casting RCC pile caps, raft, tie beams i/c reinforcement, form work -100% Area total	5.010%	10.570%
6	6.1.5	Casting RCC columns, shear walls, lift retaining wall upto bottom of grade slab i/c reinforcement, form work	3.480%	14.050%
6	6.1.6	Filling earth over RCC caps, raft, ground i/c compaction to 95% proctor's density - 100% of total area	0.380%	14.430%
6	6.1.7	Casting RCC grade slab with beams, tie beams i/c reinforcement, form work for 100% area of total	2.020%	16.450%
6	6.1.8	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to Ground Floor roof slab Level - 100% area	2.670%	19.120%
6	6.1.9	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to First Floor roof slab Level - 100% area	2.670%	21.790%
6	6.1.10	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to second Floor roof slab Level - 100% area	2.670%	24.460%
6	6.1.11	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to third Floor roof slab Level - 100% area	2.670%	27.130%
6	6.1.12	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to fourth Floor roof slab Level - 100% area	2.670%	29.800%
6	6.1.13	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to fifth Floor roof slab Level - 100% area	2.700%	32.500%
6	6.1.14	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to sixth Floor roof slab Level - 100% area	2.700%	35.200%
6	6.1.15	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to seventh Floor roof slab Level - 100% area	2.700%	37.900%
6	6.1.16	Casting RCC columns, shear walls, lift walls, staircase, beam and slab up to eighth Floor roof slab Level - 100% area	2.700%	40.600%
6	6.1.17	Casting of RCC staircase, column, beam and slab, water tank and all other RCC work at terrace floor - 100% area	1.500%	42.100%
6	6.1.18	On completion of civil finishing works as per GFC drawings & schdules.	29.880%	71.980%
6	6.2.	On completion of sanitary & plumbing works as per GFC drawings & schdules.	9.270%	81.250%
6	6.3.	On completion of internal electrical works as per GFC drawings & schdules.	8.850%	90.100%
6	6.4.	On completion of Fire alarm system as per GFC drawings & schdules.	0.350%	90.450%
6	6.5.	On completion of Lifts as per GFC drawings & schdules.	3.020%	93.470%
6	6.6.	On completion of Internal CCTV work as per GFC drawings & schdules.	0.900%	94.370%
6	6.7.	On completion of structred cabling as per GFC drawings & schdules.	0.700%	95.070%
6	6.8.	On completion of Fire fighting works as per GFC drawings & schdules.	1.110%	96.180%
6	6.9.	On completion of Airconditioning VRF / VRV system including low side works as per GFC drawings & schdules.	3.270%	99.450%

6	6.10.	On completion of Ventilation system including low side works as per GFC drawings & schedules.	0.550%	100.000%
6		Total	100.000%	
7		Construction of Ancillary & Service Block		
7	7	Completion of Construction of Ancillary & Service Block for but not limited to Electrical Sub-Station, HVAC Plant, Water tanks, Fire tanks, Sewage tanks, Sumps, STP rooms, ETP rooms, Fire Water Supply Pump rooms & MGPS Plant room - (1 Block) as per detailed scope of work, technical specification and GFC drawing. (Civil & all internal associated services as per scope of work & GFC drawings)- (95.00% of the Quoted Amount for Item No. 7.0 of Financial Quote Part H) & as per NIT		
7	7.1.1	On completion of RCC structural works as per GFC drawings & schedules.		
7	7.1.1	On completion of RCC structural works for lower ground water and STP tanks area as per GFC drawings & schedules.	32.630%	32.630%
7	7.1.2	On completion of RCC structural works for Ground floor area as per GFC drawings & schedules.	22.710%	55.340%
7	7.1.3	On completion of RCC structural works for First floor area as per GFC drawings & schedules.	13.440%	68.780%
7	7.1.4	On completion of RCC structural works for second floor area as per GFC drawings & schedules.	2.790%	71.570%
7	7.1.5	On completion of civil finishing works as per GFC drawings & schedules.	13.770%	85.340%
7	7.2.	On completion of sanitary & plumbing works as per GFC drawings & schedules.	1.040%	86.380%
7	7.3.	On completion of internal electrical works as per GFC drawings & schedules.	6.000%	92.380%
7	7.4.	On completion of Fire alarm system as per GFC drawings & schedules.	1.440%	93.820%
7	7.5.	On completion of Signage as per GFC drawings & schedules.	0.070%	93.890%
7	7.6.	On completion of Internal CCTV work as per GFC drawings & schedules.	0.470%	94.360%
7	7.7.	On completion of Fire fighting works as per GFC drawings & schedules.	0.100%	94.460%
7	7.8.	On completion of MGPS room structural civil works as per GFC drawings & schedules.	4.220%	98.680%
7	7.9.	On completion of MGPS room finishing civil works as per GFC drawings & schedules.	1.320%	100.000%
7		Total	100.000%	
8		Connecting Bridge		

8	8	Completion of Connecting Bridge 2.5 m wide between Hospital and Academic Block – 1 bridge as per detailed scope of work, technical specification and GFC drawings. (95.00% of the Quoted Amount for Item No. 8.0 of Financial Quote Part H) & as per NIT		
8	8.1	On completion of civil structural works as per GFC drawings	70.000%	70.000%
8	8.2	On completion of civil & services works as per GFC drawings	30.000%	100.000%
8	8.3	Total	100.000%	
		Boundary walls, Toilets & Guard rooms		
9	9	Completion of Boundary walls, Toilets & Guard rooms (Guard Rooms, toilets and boundary walls (Type 1, Type 2 & Type 3) shall be as per detailed scope of works, technical specifications and GFC drawings). (95.00% of the Quoted Amount for Item No. 9.0 of Financial Quote Part H) & as per NIT		
9	9.1	Boundary walls all types		
9	9.1.1	On completion of boundary walls all types RCC structural works which consist of boring piles, pile caps, retaining wall, columns as per GFC drawings	30.000%	30.000%
9	9.1.2	On completion of boundary wall civil finishing works all per GFC drawings	9.600%	39.600%
9	9.2.	Guard rooms & toilets		39.600%
9	9.2.1	On Completion of civil structural works for all guard rooms & toilets	35.000%	74.600%
9	9.2.2	On Completion of civil finishing works for all guard rooms, toilets & gates & portals above gates as per GFC drawings	24.400%	99.000%
9	9.2.3	On completion of electrical, fire fighting, low voltage system for guard rooms	1.000%	100.000%
9		Total	100.000%	
		HVAC High side works		
10	10	Completion of SITC of Mechanical and Electrical works of Central HVAC plant consisting of - Water cooled centrifugal chillers, chilled & condenser water pumps, cooling towers, close expansion tanks, separators, hot water generators along with all equipment/accessories/ electrical panels, starter, controllers, pipe works, power & control cable works, etc. complete in all respect and including all other associated works/equipment as per detailed scope of work, technical specification and GFC drawings. The scope under		

		this item shall also include SITC of chilled water and hot water piping from plant room to Hospital & chilled water piping from the plant room to the Academic building & inverter Hi wall AC unit in control room. (95.00% of the Quoted Amount for Item No. 10.0 of Financial Quote Part H) & as per NIT		
10	10.1.1	Supplying, Installing, testing & Commissioning of AHRI Certified centrifugal 2 no water chilling machine each having a capacity of 1436400 K.CAL/hour(475 TR)at at chilled water inlet/ outlet temperature of 56 Deg. F (13.33 Deg.C) / 44 Deg. F (6.67 Deg.C) with chilled water circulation rate of 950 USGPM (nominal) and condenser water inlet/ outlet temperature of 90.1 Deg. F (32.27 Deg. C)/ 100.1 Deg.F (37.83 Deg. C) with circulation rate 1425 USGPM (nominal), suitable for operation on refrigerant R-134A/R-1233ZD, each comprising complete items as per specification and as reqd. The scope of work shall include Lifting, shifting & positioning of chiller at location shown on drawing. Chiller shall be capable to unload from 100% to 20% even at constant ECWT of 92 degree farenhite, without surging and without hotgas bypass. Maximum noise sound pressure level at 1m as per AHRI 575, Shall be not more than 85 dBA. c	26.760%	
10	10.1.1	Supplying, Installing, testing & Commissioning of AHRI Certified centrifugal 2 no water chilling machine each having a capacity of 1436400 K.CAL/hour(475 TR)at at chilled water inlet/ outlet temperature of 56 Deg. F (13.33 Deg.C) / 44 Deg. F (6.67 Deg.C) with chilled water circulation rate of 950 USGPM (nominal) and condenser water inlet/ outlet temperature of 90.1 Deg. F (32.27 Deg. C)/ 100.1 Deg.F (37.83 Deg. C) with circulation rate 1425 USGPM (nominal), suitable for operation on refrigerant R-134A/R-1233ZD, each comprising complete items as per specification and as reqd. The scope of work shall include Lifting, shifting & positioning of chiller at location shown on drawing. Chiller shall be capable to unload from 100% to 20% even at constant ECWT of 92 degree farenhite, without surging and without hotgas bypass. Maximum noise sound pressure level at 1m as per AHRI 575, Shall be not more than 85 dBA. c	26.760%	
10	10.1.2	SITC of 5 no CTI Certified induced draft crossflow cooling tower with side panels in FRP/ Steel construction, FRP / Steel Hot Water & Cold Water water basins, Curtain Type PVC fills (13mill thk) & capable to withstand hot water temp. upto 54°C with integral louvers, drift eliminators, completely formed from self-extinguishing polyvinyl chloride (PVC) material (as per ASTM D-568) , having a flame spread rating of 5 per ASTM Standard E84-77a and oxygen index of 32. Hot water basin either fitted with non-clog type spray nozzles or having self rotating sprinklers, statically balanced axial flow	14.100%	

		fan, Fan & drive components (fan & motor sheaves) to be made in Aluminium Construction, split bearing shall be provided in fan shaft to divide the load over two bearings, belt driven fans with TEFC/ TEAO induction motor of class F insulation, efficiency class IE-3 suitable for operation on 415 + 10% volts,50 Hz. AC supply. Suction screen in SS Construction, make-up quick fill arrangement, vibration cut out switch, extended lubrication lines, overflow and drain connections with all necessary valves & foot valves, suitable inspection ladder, access door to enter the cooling tower with service platform/ walkway inside the cooling tower for easy access and maintenance shall be provided, steel supporting structure with proper design, anti-vibration mountings, foundation nuts, bolts, painting etc. complete as required and as per specification. For longer life of the product CT structure shall be made out of Hot dip galvanization Sheets which shall be minimum G-235 Grade on the steel frame,ladder & other accessories.		
10	10.1.3	ON SITC air circulation system as per GFC	0.280%	0.280%
10	10.1.4	On SITC of water piping system including chilled water pumps	28.500%	28.780%
10	10.1.5	on SITC of mechanical ventilation system	1.350%	30.130%
10	10.1.7	on SITC of aluminium grills, diffusers	1.750%	31.880%
10	10.1.8	On testing & commissioning complete system	0.500%	
10	10.1.9	Total	100.000%	
		External Development		
11	11	Completion of External Development of land which include filling, levelling of ground as per level sheet and Drawings, Internal roads & Footpaths, Fire tender path, Parking, plazas, Water body, fountain, Signage as per detailed scope of work, technical specification and GFC drawings. (95.00% of the Quoted Amount for Item No. 11.0 of Financial Quote Part H) & as per NIT		
11	11.01	Supplying and filling of local earth / sand from outside (including royalty) by mechanical transport including ramming and watering of the earth in layers not exceeding 20 cm in trenches, plinth, sides of foundations and over pile caps areas etc. complete.	16.490%	16.490%
11	11.02	Preparation of subgrade for roads, parking, fire tender path etc. by excavating earth to an average of 250 mm depth, dressing to camber and consolidating with 10 T capacity road roller compacting upto optimum moisture content including making good the undulation to receive	4.190%	20.680%

		the hard base and disposal of surplus earth as directed by Engineer-in-charge.		
11	11.03	Construction of granular sub-base for fire tender path & parking area etc. by providing close graded with material conforming to Grade-I (size range 75 mm to 0.075 mm) having CBR Value-30, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of 150mm thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer- in-Charge.	3.380%	24.060%
11	11.04	Construction of 100mm thick granular sub-base for fire tender path , parking area by providing close graded With material conforming to Grade-II (size range 53 mm to 0.075 mm) having CBR Value-25, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer- in-Charge.	2.290%	26.350%
11	11.05	Providing and applying tack coat on road area using hot straight run bitumen of grade VG - 10, including heating the bitumen, spraying the bitumen with mechanically operated spray unit fitted on bitumen boiler, cleaning and preparing the existing road surface as per specifications :	0.670%	27.020%
11	11.06	Providing and laying 50 mm compacted thickness Bituminous concrete using crushed stone aggregates of specified grading, premixed with bituminous binder and filler, transporting the hot mix to work site by tippers, laying with paver finisher equipped with electronic sensor to the required grade, level and alignment and rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction and density as per specification, complete and as per directions of Engineer-in-Charge -with bitumen of grade VG-30 @ 5.5% (percentage by weight of total mix) and lime filler @ 3% (percentage by weight of Aggregate) prepared in Batch Type Hot Mix Plant of 100-120 TPH capacity.	2.070%	29.090%
11	11.07	Providing and laying seal coat of premixed fine aggregate (passing 2.36 mm and retained on 180 micron sieve) with bitumen using 128 kg of bitumen of grade VG - 10 bitumen per cum of fine aggregate and 0.60 cum of fine aggregate per 100 sqm of road surface, including rolling and finishing with road roller all complete.	1.180%	30.270%
11	11.08	Providing and applying 2.5 mm thick road marking strips (retro reflective) of specified shade/ colour using hot thermoplastic material by fully/ semi automatic thermoplastic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater and profile shoe heater, driven by experienced operator on road surface with applicable specification	0.920%	31.190%

11	11.09	Providing and fixing in position M-30 grade Precast concrete Saucer Drain channel of size 300 mm wide fixed on 20 mm thick 1:4 (1 cement: 4 coarse sand) cement mortar.	1.090%	32.280%
11	11.1	Excavation in trenches for toe walls, PCC 1:4:8, and brick works in toe walls in cement mortar 1:6 as per drawings	3.330%	35.610%
11	11.11	Providing and laying C.C. pavement of mix M-25 with ready mixed concrete from batching plant. The ready mixed concrete shall be laid and finished with screed board vibrator , vacuum dewatering process and finally finished by floating, brooming with wire brush etc. complete as per specifications and directions of Engineer-in charge i/c panel shuttering work .	3.770%	39.380%
11	11.12	Providing and laying at or near ground level factory made kerb stone/Mutable Kerb of M-25 grade cement in position to the required line, level and curvature jointed with cement mortar 1:3 (1 cement : 3 coarse sand) including making joints with or without grooves (thickness of joints except at sharp) curve shall not to more than 5mm)including making drainage opening wherever required complete etc. as per direction of Engineer -in-in charge.	6.000%	45.380%
11	11.13	Providing and laying 150mm thick Dense Graded Bituminous Macadam for roads using crushed stone aggregates of specified grading, premixed with bituminous binder and filler, transporting the hot mix to work site by tippers, laying with paver finisher equipped with electronic sensor to the required grade, level and alignment and rolling with smooth wheeled, vibratory and tandem rollers as per specifications to achieve he desired compaction and density, complete as per specifications and directions of Engineer-in-Charge. 50 to 100 mm average compacted thickness with bitumen of grade VG-30 @ 5% (percentage by weight of total mix) and lime filler @ 2% (percentage by weight of Aggregate) prepared in Batch Type Hot Mix Plant of 100-120 TPH capacity	22.130%	67.510%
11	11.14	Providing and laying 80mm thick factory made chamfered edge Cement Concrete paver blocks in footpath, parks, lawns, drive ways or light traffic parking etc., of required strength, thickness & size/shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of sand, compacting and proper embedding/laying of inter locking paver block into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver block as per required size and pattern, finishing and sweeping extra sand. Complete all as per direction of Engineer-in-Charge.	6.850%	74.360%
11	11.15	Providing and laying 60mm thick factory made chamfered edge Cement Concrete paver blocks in pathways etc., of required strength, thickness & size/shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of sand,	1.410%	75.770%

		compacting and proper embedding/laying of inter locking paver block into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver block as per required size and pattern, finishing and sweeping extra sand.		
11	11.16	Supplying and laying of 30mm thick Polished steel grey & Sira grey granite with cement mortar 1:4 mixed with Cebex 112 in paving's, paving bands complete as sample approved	16.740%	92.510%
11	11.17	Supplying and laying of 30mm thick Polished steel grey & Sira grey granite with cement mortar 1:4 mixed with Cebex 112 in plaza, toe walls, copings complete as sample approved	2.910%	95.420%
11	11.18	Supplying and laying Grass Track Grass Pavers, Green honeycomb panels with self anchoring pegs, made of high impact resistant HDPE. Each grass paver should be of 330mm x 330mm X 35 mm in height consisting of four floral shaped structure of 125mm open cell and nine round cell opening of 45mm dia. Each of the open cell are connected With a web like structure for strength and stability. Base of the panel is equipped with a slot opening for drainage and four round struts for anchoring purpose. The Grass Paver to have interlock system to lock each other. The Grass Paver should have compressive strength of minimum 150 tons/sq. MT, capable to take the load of the fire tender. The panel should have high level of porosity greater than 90%,porous for Grass, shrubs and low planters. Laying to be done on 50 mm sand bed over well compacted subbase as per manufacturer specifications and directions of Engineer in charge.	1.370%	96.790%
11	11.19	Construction of water body in RCC with PCC lean, M35 grade RCC, reinforcement, waterproofing, form work, granite stone cladding, piping, valves & fountains system complete	3.210%	100.000%
11	11.1	Total	100.000%	
		STP & ETP works		
12	12	Completion of SITC of Mechanical and electrical equipment of Sewage Treatment Plant of 415 KLD & 60 KLD Effluent Treatment Plant, Water Supply System including all equipment & pumps, electrical panels, power & control cable works and all associated accessories & works as per detailed scope of work, technical specification and GFC drawings. (95.00% of the Quoted Amount for Item No. 9.0 of Financial Quote Part H) & as per NIT		
12	12.1	On SITC of ETP 60 KLD complete system	10.00%	10.00%
12	12.1	On SITC of Sewerage treatment plant 415 KLD capacity i/c pipes, pumps & accessories	60.00%	70.00%
12	12.1	On completion of electrical works for STP, ETP i/c panels, cables, pipes	5.00%	75.00%

12	12.1	On installation of pumps, accessories and piping network	15.00%	90.00%
12	12.1	On Completion, Testing & commissioning	5.00%	95.00%
12	12.1	On completion of RMO for one year	5.00%	100.00%
12	12.1	Total	100%	
		Electrical Substation works e/x building		
13	13	Completion of SITC of 33/0.433KV substation comprising of Main 33KV panel, 2500 KVA x 3 nos. transformers, RTCC panel, HT cables from the APDCL HT metering point to the main 33KV panel & from the main 33KV panel to the transformers, control cables from the transformers to the main 33KV panel, bus trunking from the transformers and DG Synchronizing cum AMF Panel to the Main LT panel, Main LT panel, Hybrid panels, APFC panels, active harmonic filters, TVSS, SPD (Surge protection system), Earthing, substation safety equipment , required inter-connections, including LT cabling from substation to all the buildings/ pump rooms, feeder pillars fed by the substation including all other works/ equipment as per detailed scope of works, technical specifications and GFC drawings. (95.00% of the Quoted Amount for Item No. 9.0 of Financial Quote Part H) & as per NIT		
13	13.1	On supply at site of 2500 KVA, oil filled 33/0.433KV, 3 phase, 50 Hz, delta/star transformer 3 no	12.000%	12.00%
13	13.2	On installation, testing & commissioning of 3 no transformers	4.000%	16.00%
13	13.3	On supply of main 33 KV HT panel at site	5.500%	21.50%
13	13.4	On installation, testing & commissioning of main HT panel	1.000%	22.50%
13	13.5	ON supply of hybrid panels, 3 nos. 400 A AHF & 400 KVAR capacitor bank and panel consisting of 100 KVAR,50 KVAR, 25KVAR, capacitor unit in tier formation; housed in an integrated cubicle type, indoor type automatic switching 'ON' and 'OFF' control panel separate from Main LT Panel complete	32.000%	54.50%
13	13.6	On installation, testing & commissioning of hybrid panels 3 no to be integrated with Main LT Panel	2.000%	56.50%
13	13.7	ON supply of 1 no. 800 A Active harmonic filter (AHF) to be integrated with Hospital Block panel in. 1 and 1 no. 600 A AHF to be integrated with Hospital Block panel -2 complete.	21.333%	77.83%
13	13.8	On installation, testing & commissioning of AHF panels 2 no to be integrated with HOSPITAL BLOCK PANEL-1&-2	1.334%	79.17%
13	13.9	On installation, testing & commissioning of balance items as shown in drawings	20.833%	100.00%

13		Total	100.000%	
		DG Sets system		
14	14	Completion of SITC of 4 nos. 1500 KVA DG Sets with acoustic enclosure & canopy, Synchronizing AMF cum Panel, Bus Ducts from the DG Sets to the Synchronizing cum AMF panel, Control cables from the DG sets and HT/ LT panels to the synchronizing cum AMF panel as required, ventilation / smoke exhaust as required, Earthing of DG set, Exhaust piping / Exhaust Chimney as per CPCB norms, Civil works connected with DG sets including foundation as required including all other associated works/ equipment as per detailed scope of works, technical specifications and GFC drawings.(95.00% of the Quoted Amount for Item No. 9.0 of Financial Quote Part H) & as per NIT		
14	14.1	ON supply of 2 nos 3 phase 415 volts 50 cycle per second, following 1500 RPM prime duty, radiator cooled 1500 KVA DG Set Diesel Generator Sets with canopy	40.00%	40.00%
14	14.2	ON supply of 2 nos 3 phase 415 volts 50 cycle per second, following 1500 RPM prime duty, radiator cooled 1500 KVA DG Set Diesel Generator Sets with canopy	40.00%	80.00%
14	14.3	ON supply, installation, testing and commissioning of 3 phase 415 volts 50 cycle per second, following 1500 RPM prime duty, radiator cooled Diesel Generator Sets - 4no	10.00%	90.00%
14	14.4	Supplying and fixing mild steel ERW exhaust piping with insulation, mild steel structural supports, mild steel fuel piping complete	9.00%	99.00%
14	14.5	Supplying, laying, installation, testing and commissioning of PVC insulated copper control cables i/c terminations complete	1.00%	100.00%
14		Total	100.0%	
		External CCTV, Lighting, Boom Barriers		
15	15	Completion of SITC of IP Based CCTV system for external building security comprising of PTZ / fixed camera, cabling, digital recording, HD display system and hardware support. Supply & Laying of data & communication cables from main server room (Hospital Block) to other buildings as per detailed scope of works, technical specifications and GFC drawings. (95.00% of the Quoted Amount for Item No. 9.0 of Financial Quote Part H) & as per NIT SITC of External lightings for Compound, Pathway, Roads, Landscape & high mast for the entire Campus.		

		SITC of Boom barriers including cable works and all other associated works as per detailed scope of work, technical specification and GFC drawings.		
15	15.1	SITC of IP Based CCTV system		
15	15.1.1	On Supply of all materials for conduiting, wires and accessories etc.	15.000%	15.00%
15	15.1.2	On Supply of cameras and accessories etc.	25.000%	40.00%
15	15.1.3	On Supply of all materials for DVR, monitor, software etc.	9.000%	49.00%
15	15.1.4	On installation of conduiting	10.000%	59.00%
15	15.1.5	On wiring, fixing equipment's	5.000%	64.00%
15	15.1.6	On Completion, testing & Commissioning	5.000%	69.00%
15	15.1.7	Supply & Laying of data & communication cables from main server room (Hospital Block) to other buildings	1.000%	70.00%
15	15.2	SITC of External lightings for Compound, Pathway, Roads, Landscape & high mast for the entire Campus		70.00%
15	15.2.1	On supply and fixing of Feeder pillars weather proof with MCCB, photo chromatic time switch	0.900%	70.90%
15	15.2.2	SITC of 6 meter High hot dip galvanised continuously tapered (bolt fixing type) octagonal Pole with top 70 mm dia and bottom 130 mm dia	2.800%	73.70%
15	15.2.3	SITC of IP66 LED street light fitting having system lumen output not less than 7000, efficacy better than 95 lumens per watt and life expectancy of 50000 hours@ L70, Power Factor > 0.90 & THD <20%, CRI better than 70,neutral white light	4.800%	78.50%
15	15.2.4	SITC of Tree Uplighter 9W IP65	1.000%	79.50%
15	15.2.5	SITC of factory wired, post top lantern Feroda hat type integrated opal acrylic for and with single 2X18 & 50 watt LED	4.900%	84.40%
15	15.2.6	SITC of factory wired, bollard light with clear with single 12 watt LED complete with all respect.	8.400%	92.80%
15	15.2.7	SITC of IP68 under water light Fully encapsulated with Opal semi translucent sealed encapsulation. CCT ranging from 2200K to 5000K, CRI>80Ra OR RGB, RGBW, tuneable white on request End caps remote driver	1.000%	93.80%
15	15.2.8	SITC of KL-4270 Nebula Bracket 18W Led Dimension:172X100X110 Luminaire	0.700%	94.50%
15	15.2.9	Providing DWC HDPE pipe with accessories 160mm / 200mm dia	1.000%	95.50%
15	15.2.10	On Completion, Testing & Commissioning	1.600%	97.10%
15	15.3	SITC of Boom barriers including cable works and all other associated works as per detailed scope of work, technical specification and GFC drawings.		97.10%

15	15.3.1	On completion of conduiting & boxes	0.300%	97.40%
15	15.3.2	On completion of cat 6 wiring	0.500%	97.90%
15	15.3.3	On supply of boom barriers with accessories	2.000%	99.90%
15	15.3.4	On installation, testing & commissioning of boom barriers	0.100%	100.00%
15	15.1	Total	100.000%	
		IBM System		
16	16	Completion of SITC of Integrated Building Management System for Digital/electronic display and monitoring of all E&M systems like substation, DG sets, Ups, Solar power, Lifts, AC Plants, Ventilation systems, Fire protection systems, Pumps etc. to include cabling, monitors, recording, display system, hardware, software support as per detailed scope of work, technical specification and GFC drawings. (95.00% of the Quoted Amount for Item No. 9.0 of Financial Quote Part H) & as per NIT		
16	16.1	On delivery of all equipment's	65.000%	65.00%
16	16.2	on installation of equipment's & cables	30.000%	95.00%
16	16.3	On Completion, Testing & Commissioning	5.000%	100.00%
16	16.4	Total	100.000%	
		Grid interactive roof top solar photo voltaic power generation system		
17	17	Completion of SITC of Grid interactive roof top solar photo voltaic power generation system of capacity 50KWp including space frame, inverter, connecting cables & all accessories in the Hospital Building. (95.00% of the Quoted Amount for Item No. 9.0 of Financial Quote Part H) & as per NIT		
17	17.1	On delivery of all Solar panels and meters, equipment's	60.00%	60.00%
17	17.2	On delivery of GI sections for frame work and accessories	7.50%	67.50%
17	17.3	On erection GI section frame work at terrace at required level i/c bracing of frame work	7.50%	75.00%
17	17.4	on installation of equipment's & cables	15.00%	90.00%
17	17.5	on completion of earthing's with GI strips connected	5.00%	95.00%
17	17.6	On Completion, testing, commissioning	5.00%	100.00%

17	17.6	Total	100.00%	
		Loose Furniture		
18	18	Completion of Loose Furniture – Non-Medical for Hospital Block, R&D cum Academic Block, Nursing Hostels, Guest House & Resident Hostels as per detailed scope of work, technical specification and GFC drawings. (95.00% of the Quoted Amount for Item No. 18.0 of Financial Quote Part H) & as per NIT		
18	18.1	On Supply and placing in position Hospital Block Furniture		
18	18.1.1	On supply and placing of Waiting Area Chairs 3 seater with or without cushion	10.00%	
18	18.1.2	Standard Medium Back chairs, low back chairs and premium high back chairs, sofas, recliners	20.47%	
18	18.1.4	Office desk tables, side units & mobile drawer units, Coffee tables , side tables, Meeting Tables, Conference tables, tall unit, working counter	14.70%	
18	18.1.6	Modular work stations with drawer units of various configuration	8.68%	
18	18.1.7	All sizes & types of Nursing stations	11.37%	
18	18.2	All types of furniture for Academic Block as per schedule	23.63%	
18	18.3	All types of furniture for Resident Hostel & Guest house as per schedule	5.42%	
18	18.4	All types of furniture for Nursing Hostel as per schedule	5.73%	
18		Total	100.00%	
		External Services – Sewerage, Effluent, Water Supply/ STP treated water supply pipe works		
19	19	Completion of SITC of External Services – Sewerage, Effluent, Water Supply/ STP treated water supply pipe works to & from buildings and to the STP/ ETP/ WS plant, Rain water harvesting & associated piping works, Storm water drainage as per detailed scope of work, technical specification and GFC drawings. (95.00% of the Quoted Amount for Item No. 19.0 of Financial Quote Part H) & as per NIT		
19	19.1	On SITC of external water supply system complete as per GFC drawings & specifications	10.300%	
19	19.2	On SITC of External Sewerage System complete as per GFC drawings & specifications	24.300%	
19	19.3	On SITC of Storm Water Drainage complete as per GFC drawings & specifications - 50 % length of total length	22.620%	
19	19.4	On SITC of Storm Water Drainage complete as per GFC drawings & specifications - 100 % length of total length	22.700%	

19	19.5	On SITC of Water Supply, Drainage Pumps & Water Treatment Equipment's as per GFC drawings & specifications	12.780%	
19	19.6	On SITC of Irrigation piping system as per GFC drawings & specifications	7.300%	
19	19.7	Total	100.000%	
		BOREWELLS		
20	20	Completion of Development of 2 nos. Bore wells of 400mm dia bore with necessary water lifting system complete as per detailed scope of work & technical specifications. (95.00% of the Quoted Amount for Item No. 20.0 of Financial Quote Part H) & as per NIT		
20	20.1	Development of 1 borewell including Boring / drilling bore well of 400 dia for casing/ strainer pipe upto 150m , by suitable method prescribed in IS: 2800 (part I), Supplying, assembling, lowering and fixing in vertical position in bore well, 200mm dia ERW (Electric Resistance Welded) FE 410 mild steel screwed and socketed/plain ended casing pipes, fittings, gravel filling, fixing 'B' class heavy duty 80mm dia G.I. pipe conforming to IS 1239 including welding, fittings like elbows, tees, flanges, tapers, nuts, bolts, gaskets, valves etc. and fixing the pipe, Supply, Lowering, installation & testing of KSB make submersible pumping set with 7.5 HP to 10 HP motor 4 stage pump suitable for 15-20 m3 hr. at 60 to 100 mtr. Head with Three Phase, & electrical panel board and 6mm sq.m aluminium cables, testing & commissioning of complete as per specifications.	50.00%	50.00%
20	20.2	Development of 1 borewell including Boring / drilling bore well of 400 dia for casing/ strainer pipe upto 150m , by suitable method prescribed in IS: 2800 (part I), Supplying, assembling, lowering and fixing in vertical position in bore well, 200mm dia ERW (Electric Resistance Welded) FE 410 mild steel screwed and socketed/plain ended casing pipes, fittings, gravel filling, fixing 'B' class heavy duty 80mm dia G.I. pipe conforming to IS 1239 including welding, fittings like elbows, tees, flanges, tapers, nuts, bolts, gaskets, valves etc. and fixing the pipe, Supply, Lowering, installation & testing of KSB make submersible pumping set with 7.5 HP to 10 HP motor 4 stage pump suitable for 15-20 m3 hr. at 60 to 100 mtr. Head with Three Phase, & electrical panel board and 6mm sq.mm aluminium cables, testing & commissioning of complete as per specifications.	50.00%	100.00%
20	20.4	Total	100.00%	
		External fire fighting system		

21	21	Completion of SITC of External firefighting works – Fire Pumps, electrical panels, MS piping, valves, hydrants, cables in plant room & pipe works to buildings & main ring complete with all other associated works/ equipment as per detailed scope of work, technical specification and GFC drawings. (95.00% of the Quoted Amount for Item No. 21.0 of Financial Quote Part H) & as per NIT		
21	21.1	On SITC of external fire fighting system work - 50% length complete as per GFC drawings.	50%	50%
21	21.2	On SITC of external fire fighting system work - 100% length complete as per GFC drawings.	50%	100%
21		Total	100%	
		Horticulture work		
22	22	Completion of Horticulture & tree plantation / shrubs / palms and potted plants operations, i/c site clearance, filling sweet earth, ground covers, grassing etc. complete with all other associated works as per detailed scope of work, technical specification and GFC drawings. (95.00% of the Quoted Amount for Item No. 22.0 of Financial Quote Part H) & as per NIT		
22	22.1	On site clearance and earth filling	40.00%	40.000%
22	22.2	On mixing earth with cowdung and chemicals and spreading for plantation	10.00%	50.000%
22	22.3	On grassings	10.00%	60.000%
22	22.4	On planting trees, palms, shrubs etc. complete as per landscaping plan complete work including all items not mentioned here but shown in GFC drawings.	40.00%	100.000%
22	22.5	Total	100.00%	

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