



**TECHNICAL CELL, EPC MISSION,
PLANNING DEPARTMENT, LUCKNOW**

**As Executing Agency of
Department of Home
Government of Uttar Pradesh**

E-Tender For

“Design, Engineering and Procurement for Construction of Non-Residential Buildings for the establishment of 5th Battalion of Special Security Force at District Saharanpur, Uttar Pradesh, India on EPC Mode.”

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TECHNICAL SPECIFICATIONS

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**Design, Engineering and Procurement for Construction of Non-Residential Buildings
for the establishment of 5th Battalion of Special Security Force at District
Saharanpur, Uttar Pradesh, India on EPC Mode**

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Technical Specifications

Civil works of Buildings

DETAILED SPECIFICATIONS

EARTH WORK

Earthwork excavation in foundation/trenches/over areas in all kind of soil/rock for desired level as per Structural/Architectural drawing for all kinds of soil and ordinary rock shall be as per CPWD Specifications- 2019 - Vol. I & Vol. II and relevant IS codes of latest edition with upto date correction slips. Any deviation in earthwork in excavation as per site condition will be ignored and nothing shall be paid extra. Top soil up to 300mm shall be preserved at site premises (protected against erosion during rain) and reused in landscaping development as per GFC drawing and CPWD specifications or as decided by Engineer-in-Charge

Excavation shall be undertaken to the width of the Basement / Retaining wall footing including necessary margins for construction operation as per drawing or directed otherwise. Where the nature of soil or the depth of the trench and season of the year, do not permit vertical sides, the contractor at his own expense shall put up the necessary shoring, strutting and planking or cut slopes with or without steps, to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer. Nothing shall be paid extra.

The contractor shall make at his own cost all necessary arrangements for maintaining water level in the area where works under execution are low enough so as not to cause any harm to the works or problems in carrying out with the execution and the rates shall be considered as inclusive of pumping out or bailing out water, if required, for which no extra payment shall be made. This will include water coming from any source, such as rains, accumulated rain water, floods, leakages from sewer and water mains, subsoil water table being high or due to any other cause whatsoever. The contractor shall make necessary provision of pumping, dredging, and bailing out water coming from all above sources and excavation and other works shall be kept free of water by providing suitable system approved by the Engineer-in-charge.

In order to avoid construction of underground structure like UGS, WTP, STP, or any basement portion of building being getting uplifted/damaged due to water pressure, the contractor shall make arrangement for lowering the ground water table below the proposed foundation level as approved by Engineer-in-charge. Sub soil water table shall be maintained at least 50 cm below the P.C.C. level during laying of P.C.C., water proofing treatment, laying of basement raft and beams including filling of earth/sand under the basement floor. The water table shall not be allowed to rise above base of raft level until completion of outer retaining walls including water proofing of vertical surface of walls and back filling along the walls up to ground level and until the

structure attains such height to counter balance the uplift pressure. However, the contractor should inspect the site and make his own assessment about sub-soil water level likely to be encountered at the time of execution and quote his rates accordingly. Scope of work are inclusive of pumping out or bailing out water, if required. Nothing extra on this account whatsoever shall be paid to him unless otherwise specified. The sequence of construction shall be got approved by the Engineer-in-charge.

All the major excavation shall be carried out by mechanical excavator. No extra payment shall be made for that.

The rates are inclusive for all depths & nothing extra shall be paid for additional lift etc.

Disposal and Shifting of Earth

Disposal of surplus excavated earth/cutting and shifting of earth to maintain required finished levels as per landscaping drawing from one area to another within the campus by mechanical transport including loading/unloading and stacking/spreading at designated location as directed by E.I.C is included in the scope of contractor and nothing will be paid extra even if contractor have to do double handling of earth.

Filling: -

The earth used for filling shall be free from all roots, grass, shrubs, rank vegetation, brushwood, tress, sapling and rubbish. Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in depth. All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or ½ tonne roller. Where specified, every third and top must layer shall also be consolidated with power roller of minimum 8 tonnes. Wherever depth of filling exceeds 1.5 metre vibratory power roller shall be used to consolidate the filing unless otherwise directed by Engineer-in-charge. The top and sides of filling shall be neatly dressed. The contractor shall make good all subsidence and shrinkage in earth fillings, embankments, traverses etc. during execution and till the completion of work unless otherwise specified.

Under Floor and Building Outer area filling: -

Filling with available excavated earth in sides of foundations & under floors shall be done only if earth found suitable, otherwise filling shall be done by bringing Moorum of approved quality and quantity from outside and nothing extra shall be paid towards the same.

Moorum of approved quality and quantity shall be filled from Natural ground level to Proposed Made up ground level as per GFC drawing outside allround the building along the perimeter to an extent of 2.4 m from building outer face. Outer area murrom filling is included in scope of contractor for every building.

All the filling (**Exacavated Earth/Moorum**) work should be done in the layers not exceeding 20cm as per CPWD specification. Each layer shall be watered, rammed and consolidated.

Landscape area

All Cutting and Filling of Earth coming to maintain the required finished level of complete Landscape area as mentioned in the landscaping/building drawing is in the scope of contractor. All filling should be done with available excavated earth and as per CPWD specifications and if the earth is not available, the same of approved quality to be brought from outside as decided by Engineer in Charge and Contractor is strictly advised to assess the required quantity beforehand and to quote his rate accordingly and nothing extra will be paid later.

Sand filling:

Supplying and filling with local sand including watering, ramming, consolidating and dressing complete as per CPWD specifications shall be provided as mentioned in GFC drawing.

Anti-Termite Chemical Treatment:

The construction measures specified below should be adopted for protection against subterranean termites originating both internally from within the plinth and externally from the area surrounding the building.

Supplying, Diluting and Injecting chemical emulsion chloropriphos/lindane E.C 20% with 1% concentration for anti-termite treatment and creating a chemical barrier for termite as per cpwd specification and as per direction of EIC.

- Treatment of soil under floors above sand filling using chemical emulsion by flooding @ 15 litre per sqm.
- Along external wall for 3m width using chemical emulsion @ 7.5 litres / sqm of the vertical surface of the substructure to a depth of 300 mm including excavation channel along the wall & rodding etc. complete.
- Along the expansion joints, surrounding of pipes & fittings and conduits @ 20litre per building.

The Contractor shall have to furnish 10 years Guarantee to maintain the anti-termite treated area / structures free from termite.

Treatment of column pits, wall trenches and basement excavations

The bottom surface and sides (up to a height of 30 cm from the bottom) of the excavations made for column pits and trenches shall be treated with the chemical emulsion mentioned above at 5 liters / sqm of surface area.

Treatment to Backfill Earth

After the column foundations and wall foundations come up, the backfill in immediate contact with the foundation structure shall be treated with the chemical emulsion at the rate of 15 liters/ Sqm of the vertical surface of the substructure 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 surfaces of the columns and walls so that the earth in contact with these surfaces is well treated with the chemical.

Treatment for R.C.C Framed Structures

The treatment described above applies essentially to masonry foundations where there are voids in the joints through which termites can seek entry into the superstructure. Hence the foundations require to be completely enveloped by a chemical barrier. In the case of RCC framed structures with columns and plinth beams, the concrete mix is rich and dense (being 1:2:4 or richer), it is unnecessary to start the treatment from the bottom excavations for columns, plinth beams and basement walls. The treatment shall start at depth of 50cm below ground level. From this depth, the backfill around the columns, beams and RCC basement walls shall be treated at the rate of 15-liters/ Sqm. of the vertical surface. The other details of the treatment shall be as laid down above.

Treatment of Top Surface of Plinth Filling

After the earth filling is completed in the plinth area and before the dry rubble packing or sub grade is laid, the entire surface of the filled earth shall be treated with the chemical emulsion at the rate of the 5 liters per Sqm. Light rodding may be carried out in the soil surface to facilitate absorption of the emulsion.

Treatment at Junction of Walls and Floor

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surface from the ground level 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 floor (before laying the sub grade) and rod holes made in the channel up to the ground level 15 cm apart and the rod moved backward and forward to break up the earth and chemical emulsion poured along the channel at the rate of 15 litre/ Sq.m of the area of the vertical surface of the wall surface of the sub-structure so as to soak the soil right to the bottom. The soil should be tamped back into place after this operation.

Treatment to Soil along External Perimeter of Building

Finally, the earth around the external perimeter of the building up to a depth of 30cm shall be treated at the rate of 4.5 litres per running meter of plinth wall. To facilitate this treatment, solid M.S. rods should be driven into the soil as close as possible to plinth wall at intervals of 15 cm and up to a depth of 30 cm and the rods moved backwards and forwards in a direction parallel to the wall to break up the earth so that the chemical emulsion mixes intimately with soil.

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 conduit 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.

Termite Proof Course or DPC (PCC) in Plinth

Where there is the provision of a damp-proof course in the construction, it is located just below the level of the filled earth. Although this acts as an effective barrier impervious to termite entry the PCC surface should be treated at 5 litres per Sq.m immediately after the course is laid and the concrete is green. Where there is no provision for a DPC, the top surface of the masonry course just below the level of plinth filling mentioned above should be soaked with the chemical emulsion at the rate of 5 litres per Sq.m. of the surface. The application should be carried out slowly to enable the masonry surface to absorb the emulsion.

Guarantee

The Contractor shall guarantee the anti-termite work for a period of 10 years from date of completion. The guarantee will cover the surfaces treated and will bind the Contractor to perform remedial measures, at his expense including but not limited to repeat of anti-termite work in the affected area/zone. The guarantee shall be in the form of irrevocable bank guarantee for an amount equivalent to 10% of the total sum paid to the Contractor for anti-termite treatment work valid for a period of 10 years complying.

Contractors must ensure that the work is done through a professional pest control operator who is a member of Indian Pest Control Association or other recognized professional body. A list of termite control jobs successfully undertaken for Government Departments, Statutory bodies or large private organizations are to be provided to prove that they are capable of handling anti-termite work.

Reinforced cement concrete/ PCC in substructure

Foundation shall be with RCC isolated/ stripped/ combined, Raft type footing as per structural drawing using Ready mixed grade concrete as mentioned in drawing. Columns are connected by grade (external) beams/plinth (Internal) beams below Ground level as per structural drawing and wherever necessary additional tie beams shall be provided in between grade beams/ plinth beams & top of footing based on the depth of footing. All Pedestals & columns above foundation, plinth beams, tie beams etc shall be as per structural drawing with Ready mixed grade concrete as mentioned in drawing. Reinforcement steel as per drawings to be provided and Slab on grade below floor finish with Ready mixed grade concrete slab include reinforcement steel as per drawings. Base concrete below the footing, plinth beam, grade slab, etc. shall be of grade 1:4:8 minimum thickness of 75 mm or as mentioned in GFC drawing. To maintain the cover to reinforcement in structural members only factory-made cover blocks of required size and grade not lesser than the grade of concrete have to be used.

Brick work in foundation and plinth

Non modular well burnt clay of class M-75/ Cement based flyash bricks in foundation in cement mortar 1:4 (1 Cement: 4 Coarse sand).

Damp Proof Course

Damp proof course shall be with 50 mm thick cement concrete 1:2:4 (1cement: 2 coarse sand: 4 graded stone aggregate 12.5mm nominal size) mixed with approved water proofing compound painted at top with a coat of residual petroleum bitumen of grade VG-10 of approved quality at 1.7 kg/sqm.

Plinth Protection

Plinth Protection shall be 40mm thick rough Bilha stone with machine cut edges (straight or raked as called for) or as specified in drawing to the pattern laid over a 20mm thick bed of cement mortar 1:4 (1cement :4 coarse sand) with fine joints filled with cement mortar 1:2 (1cement :2 coarse sand) pigmented to match the stone. Brick edging, PCC& hardcore all sections as shown in GFC drawing.

Light weight sunken floor filling:

Providing and laying machine mixed Autoclaved aerated cement (AAC) blocks concrete in volumetric proportion 1:4:8 (1 cement: 4 coarse sand : 8 AAC block aggregate 40 mm nominal size) for specified thickness, for sunk floor, in depressed portions of toilets, terraces etc. in super structure at all heights & levels, including centering and shuttering if required, laying spreading, ramming, consolidating as per requirement and curing etc. complete as directed.

Reinforced cement concrete/ PCC in superstructure:

All RCC Columns, walls, beams, slabs etc. shall be as per structural drawing with required grade designed RMC concrete. To maintain the Cover to reinforcement in structural member, only factory-made cover blocks of required size and grade not lesser than the grade of concrete in RCC works have to be used. As far as possible, no honeycombing is accepted, but if any minor rectification required it shall only be done with GP2/Epoxy grout and not by Cement mortar.

Curing of RCC & PCC

Curing of concrete is most important. There shall be no compromise on this activity and it is for the contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the Engineer-in-Charge. Concrete shall be protected from quick drying with moist or damped hessian cloth or any other material approved by the Engineer-in-Charge. After 24 hours of laying of the concrete, the surface shall be cured by flooding with water or covering with damp hessian cloth for a period of 7 days to keep it moist and for the next 7 days the surface shall be kept wet all the time by sprinkling water continuously or as per CPWD specifications.

If required, for columns and other vertical surface curing compound of approved make can be used as per the direction of E.I.C.

SHUTTERING / FORM WORK: -

The work shall be done in accordance with CPWD Specifications - 2019 - Vol.I& Vol. II with upto date correction slips.

Steel shuttering and 12 mm thick BWP grade film faced plywood shuttering to be used in the work by contractor as per direction of engineer in charge. All shuttering brought at site should be new/fresh when used for the first time and should not be allowed more than permissible repetition or quality of surface of shuttering become uneven which ever is earlier

- Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required to complete the shuttering panels. Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work and Props of steel shall be provided with adequate horizontal and cross - bracing. Steel props shall use steel pipes and steel couplers.
- Form work including centering, shuttering, propping, staging shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Form work shall be properly designed for self-weight, weight of reinforcement, weight of fresh concrete, and in addition, the various live loads likely to be imposed during the construction process (such as workmen, materials and equipment). In case the height of centering exceeds 3.50 meters, the prop may be provided in multi-stages. It is important to note here that Designing of formwork/shuttering as per CPWD specifications/relevant IS codes for RCC work i.e column/wall/beam/slab at all heights and level as shown in GFC drawing is the responsibility of contractor and if any mishap happens during execution of RCC work due to design/workmanship fault etc, then it will be the sole responsibility of Contractor.

Workmanship:

Contractor shall account for all material and labour etc. to achieve the required finishes to the satisfaction of the E-I-C:

- The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or debonding compound shall be applied on the surface of the shuttering plates in the requisite quantity before assembly of steel reinforcement.
- The joint filler shall be resilient closed cell expanded polyethene and non- tainting as manufactured by Supreme Industries Ltd or equivalent.
- Providing joint filler of required thickness in position to substrate using either double sided foam adhesive tape or neoprene synthetic rubber adhesive. When forming expansion joint with the Board in in-situ concrete, joint sealing slots can be readily formed in the following matter-

- a) Before installing, simply cut off a strip of the required depth. Then install the filler flush with the finished surface.
 - b) Prior to sealing, the top strip can then be pulled easily from the joint to provide an uncontaminated sealing slot ready for preparation and sealing.
- Form shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections, care shall be taken to see that no piece is keyed into the concrete.
 - Shuttering surface before concreting should be free from any defect/ deposits and fully cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness before use.
 - Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per metre (1 to 250) or as directed by the E-I-C, so as to offset the subsequent deflection, for cantilevers the camber at free end shall be 1/50th of the projected length or as directed by the E-I-C.
 - Erection of form work may be from pre-moulded, pre-fabricated, pre-assembled plates or forms reasonable enough to transport and erect at site to correct line and level as set out at site. Supports shall be firm and maintained in position by nails, cross bracings, tie rods, locking bolts and nuts. It shall be rigid and stiff so as to retain its shape during and after concreting. The tie rods shall be terminated at least 40mm inside the finished surface.
 - Joints shall be water-tight and no cement slurry shall be allowed to slipthrough. In joints foamed tapes shall be used.
 - Pre-fabricated or site forms shall be assembled, so as to deshutter without any jerk to the green concrete. For this double wedge shall be used. Wedges shall be nailed, the heads reasonably left out, allowing easy removal while deshuttering.
 - Pre-fabricated or on site fabricated forms shall be of sufficient thickness and with the required supporting runners in either direction. Supporting runners shall be standardised in size for easy replacement and universal use at site.
 - In repeated use, panels shall be clearly marked for using at defined locations.
 - Successive lift shall be tightened with previous lift by fixing foamed strips at joints to avoid grout leakage.
 - In fill pieces and panels shall be well dressed, leveled and jointed with main formwork so as to achieve smooth, even natural finish.
 - Provide and fix or fix only inserts pockets, to correct line and level and with sufficient rigidity to keep in position while concrete placing is in progress along with vibration.
 - Sloping, brackets, chajjasetc shall be well secured and firmly restrained.
 - Adequate access and working platform shall be arranged with required safety to avoid reinforcement displacement, damage to shuttering and easy movement of concrete gang.
 - Props and scaffolds are to be erected to correct plumb, line, level and with required tie. Load carrying capacity of props shall be as per table of manufacturer.

- Props and scaffolds shall not be loaded more than allowed by manufacturer of Props /scaffolds.
- Heavy, medium and light duty props shall not be mixed up.
- All angles and corners shall be sharp and well defined. In places where concrete edges are permanently exposed and require no further treatment, they shall be chamfered in a triangle of 25x25mm.
- At the design and erection stage, the following additional points shall be considered and incorporated into the shutters.
- Openings for cleaning prior to start of concreting.
- Pouring points shall avoid high drops and provide easy access to vibrator needles. Surfaces shall be treated with mould releasing oil or emulsion prior to reinforcement laying.
- Joints of moulds shall be water-tight & should be checked from bottom to make sure that no light is visible.
- Props shall be on solid base, plumbed, in one straight line, and braced horizontally and cross.
- Tie bars in beams, walls and columns shall be at the correct place and fully tight.
- Wedges shall be fully secured and nailed with head left out for easy removal.
- All saw dust, dirt, shaving and any other unwanted materials shall be cleaned and hosed out.
- Provision shall be made for watching form work while concreting and any other platform needed for movement of workers without any disturbance to reinforcement.
- Opening/inserts: All required openings and pockets shall be provided as detailed in the drawing. The contractor shall provide for the required material, labour for fixing and supporting during concreting, in his quoted price. It is imperative that all openings and pockets shall be deshuttered with care and all corners of openings shall be preserved. All openings/pockets shall be in a correct line and level. After concreting, the openings shall be secured by proper covering against any accident and guard rail and warning notice, if any will be incorporated.
- In case of multistory building, the concreting of upper floor shall be done only after lower floors have attained the strength.
- In case of shear walls, lift walls, internal walls, the form work shall be done by removable type tie rods within PVC sleeves.

Note: - Tolerance in Finished concrete and class of surface finish should be as per CPWD Specification.

Formwork for exposed concrete surfaces: -

- Where it is specifically shown on the GFC drawings to have Expose concrete finish or original fair face finish of concrete surface without any rendering of plastering, 12 mm thick BWP grade type 3 film faced plywood of CSFF designation confirming to IS: 4990 for form finished/ fair faced concrete surface as per acceptance criteria where ever required as per the Architectural GFC drawing. The BWP type 3 ply to be used can have maximum 3 repetition only.
- The forms shall be constructed so as to produce a uniform and consistent texture and pattern on the face of the concrete. The formwork shall be placed so that all

horizontals are constructed of lumber and are not paneled and the formwork joints shall be staggered.

- To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Whenever possible, joints between sheets shall be arranged to coincide with architectural feature, sills, window heads or change in direction of surface. All joints between panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be approved between sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.
- Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicate top of pour) at horizontal constructions joints, unless the use of groove strips is specified on the drawings. The reset forms shall be tightened against the concrete so that the forms will not be spread and permit abrupt irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.
- For fair faced concrete, the position of through bolts will be restricted and generally as indicated on the drawings.
- Plywood used in the formwork for obtaining exposed surfaces shall be got approved from Engineer-in-Charge on each use. However, no forms will be allowed for reuse if it is doubtful to produce desired texture of exposed concrete.
- Cement of only approved shade shall be used preferably of single lot to achieve integrity of texture.

REINFORCEMENT: -

Reinforcement bars shall be Thermo-Mechanically Treated (TMT) bars of min grade Fe-500D. Conforming to IS 1786. Steel shall be fresh and new. It shall be free of defects and free of rust, oil, paints, grease, loose mill scale or any other deleterious material undesirable for RCC or prevent adhesion of concrete with reinforcement. The contractor shall procure TMT bars from primary steel producers conforming to related IS Code and standards. All reinforcement bars brought at site shall be tested prior to use for respective specification / physical properties. Only material acceptable as per IS shall be allowed into the works. Workshop shall be installed at site for fabrication of steel.

Binding wires: Binding wire shall be 16 or 18 gauge annealed wire conforming to IS 280. It shall be free from rust, oil, paint, grease, loose mill scale or any other deleterious material undesirable for the reinforcement and concrete or which may prevent adhesion of concrete with reinforcement.

Workmanship

- Fabrication of reinforcement: Reinforcement shall be fabricated as per the structural drawing and approved bar bending schedule. Bending of material shall be cold bending only. Anchoring of bars and stirrups shall be provided exactly as detailed in the GFC structural drawing or as directed by the E-I-C.

- Laps shall be strictly as per the GFC drawing or as per CPWD Specification. For general guidance, the following principles shall be followed as given in IS 456.
- Mechanical Reinforcement coupler of adequate strength, length and internal thread and confirming to performance requirements as per IS code 16172:2014 can be used by contractor for diameter 25mm and above in place of Lapping but nothing extra will be paid for the same.
- The reinforcement shall be done as per CPWD Specifications - 2019 - Vol.I& Vol. II with upto date correction slips.
- The item of reinforcement of RCC work includes all operations including straightening, cutting, bending, binding and placing in position at all the floors with all leads and lift complete as per CPWD Specification - 2009 - Vol.I& Vol. II with upto date correction slips.
- To avoid displacement of bars in any direction and to ensure proper cover, only factory-made round type/rectangular cover blocks of same block of parent concrete shall be used by the contractor. Nothing extra shall be payable on this account.

MASONRY WORK

All external walls as per GFC drawings shall be Well burnt clay Bricks/Red Brick of Class M-150/ cement based Fly Ash brick walls of thickness 400 mm (consisting of 230 mm external wall in cement mortar 1:6 (1 cement: 6 coarse sand) & 115 mm internal wall in cement mortar 1:4 (1 cement: 4 coarse sand)) / 300 mm (consisting of two no. 115 mm wall in cement mortar 1:4 (1 cement: 4 coarse sand)) / 230 mm thick single wall in cement mortar 1:6 (1 cement: 6 coarse sand)

All Internal walls as shown in the drawing shall be autoclaved aerated cement blocks masonry of given thickness / 115mm thick brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) with Well burnt clay Bricks/Red Brick of Class M-150 or cement-based fly ash bricks / 230mm thick bricks masonry in cement mortar 1:6 (1 cement: 6 coarse sand) with Well burnt clay Bricks/Red Brick of Class M-150 or cement-based fly ash bricks.

Brick Masonry

Unless otherwise specified Well burnt clay Bricks/Red Brick of Class M-150 shall be used in all items of brick work. The classification of bricks brought by the contractor shall strictly conform to CPWD Specifications – 2019 Vol-1 & II with upto date correction slips or as specified.

Note: - Half masonry with cement mortar (1:4) shall be provided with RCC bands of required thickness as shown in GFC drawing at the Sill and Lintel level or as directed by E.I.C.

Autoclaved Aerated Cement Blocks Masonry

AAC Block shall confirm to IS:2185(Part-III) and shall be of grade-I of minimum density 551 to 650 kg/cum with minimum compressive strength 4.0 N/sqmm.

Providing and laying autoclaved aerated cement blocks masonry with 100 mm thick AAC blocks in super structure above plinth level up to all level in block laying polymer modified adhesive mortar, with required thickness of RCC bands as shown in GFC drawing at sill level and lintel level or every 1.2m as directed by Engineer-in-charge.

Providing and laying autoclaved aerated cement blocks masonry with 200mm/300 mm thick or as specified in GFC drawing. AAC blocks in super structure above plinth level up to all level with required thickness RCC band as per GFC Drawing at sill level and lintel level or every 1.2m as directed by Engineer-in-charge with approved block laying polymer modified adhesive mortar all complete as per direction of Engineer-in-Charge.

CAVITY WALL: -

It is a wall comprising of two leaves, each leaf being built of masonry units and separated by a cavity so as to provide an air space within the wall and tied together with metal ties or bonding units to ensure that two leaves act as one structural unit. The width of the cavity shall not be less than 50 mm and not more than 115 mm. Each leaf of the cavity wall shall not be less than 75 mm. The space between the leaves being either left as cavity or filled with non-load bearing insulating and water proofing material as given in drawing.

The cavity between the walls shall be filled with cement concrete 1:2:4 (1 cement: 2 coarse sand :4 graded stone aggregate 20 mm nominal size) up to plinth level & filled with 50 mm thick extruded polystyrene rigid insulation board in super structure as per architectural drawings.

The item shall include use of device for keeping cavity clear and forming the requisite weep and vent holes as shown in architectural drawings.

Bonding units for Cavity wall

These shall be preferably precast R.C.C. units having cross-section based on the width of cavity wall. Length of the Bonding units will be sum of thickness of both leaves plus width of cavity. Width & Thickness are same as bricks used in the construction of cavity wall. Cement concrete used in the bonding units shall not be leaner than 1:2:4 (1 cement: 2 coarse sand :4 graded stone aggregate 20 mm nominal size).

Spacing: -Bonding units shall be spaced not more than 90 cm apart horizontally and 45 cm vertically and staggered in each course. Additional ties shall be used near openings. Precast R.C.C. bonding units provided in cavity wall shall not be less than 3 blocks per sqm.

Restrictions: -Cavity walls shall not normally be built more than 7.5 metres in height and 9 metres in length. Where large lengths and heights are desired, the wall shall be divided into panels with strengthening measures such as pillars etc.

Adoption of cavity walls is not recommended when heavy concentrated load from beam etc. are to be supported by walls.

SWG Aluminium sheet in cavity walls

28 SWG Aluminium sheet of required profile, size & shape shall be fixed in cavity walls as indicated in drawing or as per the directions of the Engineer-in-charge, with 75mm laps at the joints in the sheet including providing and laying cement concrete fillet in mix 1:3:6 (1 cement: 3 coarse sand: 6 coarse aggregate 12.5 mm nominal size) at the bottom of cavity.

Installation: - Cement concrete fillet in mix 1:3:6 provided at the bottom of cavity in the profile as shown in drawings. Over the cement concrete fillet 28 SWG Aluminium sheet provided as profiled to the required shape as indicated in drawing. Minimum overlap shall be 75 mm provided at the joints of sheet.

19 mm dia PVC pipe in cavity walls

19 mm dia (OD), 150mm long, 2 mm wall thickness PVC pipes of approved make shall be fixed in cavity walls with galvanized mosquito netting over mouth of pipe, pipes placed at the required spacing and aligning the same vertically and horizontally etc. complete as per drawing.

Installation: - The pipe shall be cut to size as per drawing or as required, galvanized mosquito netting fixed over mouth of pipe with the help of galvanized steel wire and the pipe placed at location and required spacing as shown in drawing.

50 mm thick extruded polystyrene in between cavity wall

50 mm thick extruded polystyrene rigid insulation board of required size shall be fixed inside cavity wall, complying with ISO 4898:2008 & ASTM C 578-08b - type VI, having thermal conductivity of 0.0289 W/m K as per ASTM C 578 (measured as per IS 3346), compressive strength of > 350 kPa listed as per ASTM D 1621, density of 34-36 kg/cum as per ASTM D 1622, water absorption < 1% by volume as per ASTM D 2842, oxygen index of 24.1 to 28.1 listed as per ASTM D 2863, cell size 0.4 mm of dia (max) as per ASTM D 3576. Fire retardant property as per DIN 4102, Part 1 of class B2 and as per ASTM E84 class A, fixed with suitable water based adhesive or fastener, complete in all respect as shown in Architectural drawings or as per the directions of Engineer-in-Charge.

Expansion Joint System and Filler Board

Expansion joint filler Board of 25mm, 100 mm & 150 mm thickness.

Expansion joint filler Board is alkali resistant, closed cell, polymer based for RCC columns, Beams, Walls and slabs. It is non-staining and non deteriorating expansion joint filler for buildings.

Features required: -

- Closed cell- Negligible water / moisture absorption.
- Bitumen free -Non impregnated, non staining and Non bleeding. Does not disintegrate.
- Easy to use - no crumbs, dust or fibres, easy cutting by knife
- Chemical resistance – unaffected by acids, Alkalis, detergents, petrochemical products
- Excellent recovery hence can accommodate joint movement
- Will not discolour sealants or architectural substrates
- Thickness is built up using minimum 10 mm thick layer of specifically Extruded high performance Sheet.

Providing & Fixing Expansion joint filler Board of Dawn Color of approved make, thickness built up using minimum 10mm specifically extruded high performance sheet of minimum density 28 kg / Cum including using adhesive or double sided adhesive tape to the casted surface to form the expansion joint of required width. Filler board will become one side of the shuttering while the expansion joint is being created. This item shall have included preparation of surfaces by cleaning of dust, oil, loose aggregate etc.,

Installation: - The Expansion joint board shall be cut to size as per the depth of expansion joints required. The Expansion joint board shall be shorter than the face of the expansion joints to allow installation of Seal / backer rod as per manufacturer's specification. The sheet shall be put in to place inside the expansion joints using suitable adhesive material with low VOC as per GRIHA norms. Care should be taken during installation to prevent any adhesive from sticking outside the expansion joints. Gaps of various sizes over or below 25mm/100 mm / 150mm shall have to be filled using the same Expansion joint board cut at site to give a tight fit.

EXPANSION JOINT SYSTEM

Expansion joint system (floor/wall (internal and external)/ceiling) of approved make and for required gap to be provided wherever joint is coming as shown in drawing or as decided by Engineer-in-Charge.

Floor Joint

Providing and fixing of heavy-duty expansion joint system related with floor location as per drawings and direction of Engineer-In-Charge. The joints system will be of extruded aluminum base members, self aligning / self centering arrangement and support plates etc. as per ASTM B221-02. The system shall be such that it provides floor to floor /floor to wall expansion control system for various locations that

accommodates multi directional seismic movement without stress to it's components. System shall consist of metal profiles with a universal aluminum base member designed to accommodate various project conditions and finish floor treatments. The cover plate shall be designed of width and thickness required to satisfy projects movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self-centering arrangement that freely rotates / moves in all directions. The Exp. Joint Cover should have an Articulated Telescope Design so as to accommodate the movements in 3 directions. Provision of Moisture/water Barrier Membrane in the Joint System to have watertight joint is mandatory requirement all as per the manufacturers design and as approved by Engineer -in-Charge including cost of all materials and fixtures, preparation of surface for receiving the joints and system to be installed by company authorised vendor or as approved by Engineer in charge including all leads and lifts etc. (Material shall conform to ASTM 6063).

Wall / Ceiling Joint

Expansion joint system related with wall / ceiling joint (internal / external) location as per drawings and direction of Engineer-In- Charge. The joints shall be of extruded aluminum base members, self aligning / centering arrangement and support plates as per ASTM B221- 02. The material shall be such that it provides an Expansion Joints System suitable for vertical wall to wall/ wall to corner application/ Ceiling to Ceiling / Ceiling to wall corner, both new and existing construction with no slipping down tendency amongst the components of the Joint System. The Joint System shall utilize light weight aluminum profiles exhibiting minimal exposed aluminum surfaces mechanically snap locking the multicellular to facilitate movement. Preparation of surface for receiving the joints and system to be installed by company authorized/trained vendors as per the manufacturers design and as approved by Engineer -in-Charge (Material shall conform to ASTM 6063)

Performance Requirement: Material and works shall conform to the latest edition of reference specifications as specified in the item and to all applicable codes and requirement of local authorities having jurisdiction.

Approval of expansion joint system: Sample of expansion joint system along with manufacturers latest published literature for material specified herein, material test reports, shop drawings etc. shall be submitted for obtaining approval before material are delivered at the site. The expansion joint cover assembly should be from one source (from single manufacturer)

Installation of expansion joint system: In all cases the manufacturer's standard written instruction or specific instructions for installation shall be followed.

Note: - For all external wall joint the expansion joint system shall be used with Moisture / Water Barrier Membrane.

FLUSH DOOR

35 mm thick Flush doors with 1 mm lamination both side : All flush doors as shown in GFC Drawing shall be 37 mm(35mm+1mm+1mm) thick factory made Flush Door shutters conforming to IS : 2202 (part-1) non-decorative type, core of block board construction with frame of 1st class hard wood and well matched commercial

3ply veneering with vertical grains or cross bands and face veneers on both faces of shutters. Edges of the shutter should be provided with lipping with 2nd class teak wood battens 12 mm minimum depth on all edges of shutters. 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 confirming to IS : 2046 Type S to be provided on both side of shutter.

All flush door shutters shall be fixed with ISI marked stainless steel grade 304 butt hinges of size as mentioned in the architectural drawing. Vision Panels shall be provided as per details & size mentioned in GFC drawing.

NOTE: - The high pressure pasting of laminate over flush door shutter shall be done at factory itself and vision panel to be provided as per drawing.

HINGED TYPE SLIDING FOLDING SYSTEM

Providing & Fixing hinged type sliding folding system (ceiling mounted) of approved make as per manufacturer's specification for 37 mm thick factory made Pre-laminated Flush Door shutters conforming to IS : 2202 (Phenol formaldehyde resin bonded & shall be a green rated product) of size 3000 mm wide & upto 2400 mm height. Out of four shutter panels, two Panels each of width approximately 750 / 800 mm Sliding and Folding towards left & Two Panels towards right manually.

Note:- The above work shall be done by manufacturers authorized applicator/trained/recommended or as directed by engineer in charge.

ALUMINIUM WORK

Aluminium work for doors, windows, ventilators and partitions shall be with powder coated as per approved shade (minimum thickness of powder coating 60 micron) 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, necessary filling up the gaps at junctions, i.e. at top, bottom and sides shall be 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 GFC architectural drawings and the directions of E-I-C.

Sub frame : Aluminium (minimum thickness of powder coating 60 micron) sub frame work to be provided prior to finishing work, as per architectural drawing for all external & internal doors, windows and ventilators with extruded built-up standard tubular sections of approved make conforming to IS: 733 and IS: 1285, fixed with rawl plugs and stainless steel screws etc.

Aluminium doors : All Aluminium doors shall be powder coated aluminium glazed doors (minimum thickness of powder coating 50 micron) as per GFC architectural drawings . All aluminium doors shall be fixed with stainless steel grade 304 hinges of

size as mentioned in the architectural drawing. Stainless steel grade 304 hardwares shall be fixed as per schedule of hardware or as shown in architectural drawing.

Windows / Ventilators: All aluminium windows, ventilators & internal partitions shall be powder coated (minimum thickness of powder coating 50 micron) as per GFC architectural drawings. All openable window shutters shall be fixed with 300mm length adjustable heavy-duty friction stays & have single point locking handles without key of approved make powder coated to required colour or shade as per drawing. Toilet ventilators shall be powder coated aluminium shutter with fixed /top hung / aluminium louvers as per drawing.

Glazing: Glazing to be provided and fixed With float glass panes of 5 mm thickness (weight not less than 12.50 kg/sqm) 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.

Fly proof mosquito mesh: Fly proof mesh shall be stainless steel grade 304 wire gauge, to windows and clerestory windows using wire gauge with average width of aperture 1.4 mm in both directions with wire of dia. 0.50 mm all complete with aluminium beading.

Silicone Sealant and Neoprene Gasket

Neoprene/EPDM Gaskets

The contractor shall provide and install e gaskets of approved size and profile at all locations as shown and as called for to render the doors, windows etc. absolutely air tight and weather tight. The contractors shall produce samples of the gaskets for approval and procure after approval only.

Silicone Sealant

The gaps between frames and supports and also any gaps in the windows section shall be raked out as directed and filled with sealant of approved colour and make to ensure complete water tightness.

Application of sealant and gasket

- Sealant and gasket shall be provided wherever shown in the drawings or required for a permanently weather tight installation.
- All adjoining surfaces shall be protected to receive sealant against staining by masking and/ or other methods.
- Joints and joint surfaces shall be clean, dry, and free of any material that may have an adverse effect on the bonding and/ or seal of the sealant and gasket materials.
- Apply sealant and gasket under the conditions recommended by the manufacturer(s). Prime all surface to receive sealant and gasket unless

recommended otherwise, use no sealant that has started to set in its container or a sealant that has exceeded the self life published by the manufacturer.

- Fill all joints continuously and completely with sealant, forming a neat, uniform, concave bead. Finish the material flush with adjoining surfaces unless shown on the drawings. All sealant surfaces shall be tooled smooth.

Hardware schedule:-All Doors and window to provided with necessary hardwares as shown in Hardware schedule/drawing i.e stainless steel grade 304 hardware & fittings (such as hinges, door closers, Dead Locks / Electromagnetic lock / mortise Locks / mortise bathroom lock, lever & pull handles, tower bolts, Floor & wall door stoppers ,vision panels etc., & windows / ventilators shall be provided with stainless steel grade 304 hinges, 300mm length adjustable heavy duty friction stays & Single point locking powder coated handles without Key.

Shop Drawings

The contractor shall submit the shop drawings of doors. Windows, louvers, cladding and other aluminum work, based on architectural drawings well in advance preferably 60 days before procurement to the Engineer-in-Charge for approval. The drawings shall show full size sections of doors, windows etc. thickness of metal (i.e wall thickness), details of construction, sub frame/ rough ground profile, anchoring details, hardware as well as connection of windows, doors and other metal work to adjacent work.

Samples

Samples of doors, windows, louvers etc. shall be fabricated, assembled and submitted to the Engineer-in-Charge for approval. They shall be of sizes types etc. as decided by Engineer-in-Charge. All samples shall be provided at the cost of the contractor and shall be submitted to the Engineer-in-Charge for approval well in advance of commencing the work

Fabrication

Doors, windows, etc. shall be fabricated to sizes as shown and shall be of section, sizes combinations and details as shown in the Architectural Drawings. All doors, windows etc. shall have mechanical joints. All members shall be accurately machined and fitted to form hairline joints prior to assembly. The joint and accessories such as cleats, brackets, etc. shall be of such materials as not to cause any bimetallic action. The fabrication of doors, windows, etc. shall be done in suitable sections to facilitate easy transportation, handling and installation. Adequate provision shall be made in the door and window members for anchoring to support and fixing of hardware and other fixtures as approved by the Engineer-in-Charge.

Protection of Finish

Polythene tape/bubble sheet protection shall be applied on the powder coated section before they are brought to site. All care shall be taken to ensure surface protection during transportation, storage at site and installation. The tape protection shall be removed on installation. All aluminum members shall be wrapped with approved self adhesive non- staining PVC tapes/bubble sheet till completion / handing over of the building whichever is later. If any scratches and damages occurs shall be replaced or rectified at their own cost and noting extra shall be paid against the same.

Hardware for doors and window

All Doors and window to provided with necessary hardwares as shown in Hardware schedule/drawing. Hardware shall be of Stainless-steel grade AISI 304 / AISI 316 & as per European standard whenever applicable. All hardware should be of Satin finish or as decided by Engineer in charge.

Stainless steel Screw used for fitting shall be of same metal and finish as the fitting otherwise specified.

Samples & shop drawing: The Contractor shall prepare & submit shop drawings & samples of all hardwares used & got approved from the Architect & Engineering-in-Charge prior to the execution of work.

The detail list of hardware schedule is mentioned below. Although the tentative quantity of particular items is mentioned in hardware schedule attached.

1. Stainless steel grade 304 satin finish tower bolts 150mm
2. Stainless steel grade 304 satin finish tower bolts 300mm
3. Stainless steel grade 304 satin finish pull handle 19 mm dia x 150 mm long
4. Stainless steel grade 304 satin finish pull handle 19 mm dia x 200 mm long
5. Stainless steel grade 304 satin finish pull handle 22 mm dia x 300 mm long
6. Stainless steel grade 304 satin finish pull handle 38 mm dia x 1200 mm long
7. Satin stainless steel Foot operated Door Stopper with rubber buffer
8. Satin stainless steel wall mounted Door Stopper with rubber buffer
9. Single point locking handles without Key for window
10. Mortise lock with Euro Profile half Cylinder with one side Key & pairs of lever handle with rose & escutcheons.
11. Mortice bathroom lock, strike plate, bathroom escutcheons with indicator &

spindle & pairs of lever handle with rose

12. Backset dead lock with Euro Profile Cylinder with both side Key operation including strike plate & escutcheons
13. External Trim with panic device with cylinder & Key.
14. Stainless Steel Ball bearing hinges & Spring hinges for double action swing doors
15. Surface mounted door closer
16. Electronic Deadbolt for double action swing doors
17. Single electromagnetic lock with 600 lbf (2668 N) holding force, surface-mounted, with lock status sensor and red/green LED indicator, anodized aluminium finish. Power supply: 12/24 V DC
18. Double electromagnetic lock with 600 lbf (2668 N) holding force per magnet, surface-mounted, with lock status sensor and red/green LED indicator, anodized aluminium finish. Power supply: 12/24 V DC
19. Single electromagnetic lock with 1200 lbf (5338 N) holding force, surface-mounted, with lock status sensor and red/green LED indicator, anodized aluminium finish. Power supply: 12/24 V DC
20. Double electromagnetic lock with 1200 lbf (5338 N) holding force per magnet, surface-mounted, with lock status sensor and red/green LED indicator, anodized aluminium finish. Power supply: 12/24 V DC.
21. 300mm length adjustable heavy duty friction stays for window
22. Hydraulic floor spring with double spring mechanism and door weight upto 125 kg

GLAZING WORK

Glazing in aluminium doors, windows, ventilators shutters and partitions, spider glazing, structural glazing & skylights etc. shall be with 5.5 mm thick single glass panel/ 5 mm thick single high performance toughened glass / 24 mm thick double glazed dual sealed insulating toughened glass / 31.52 mm thick Double glazed dual sealed insulating toughened glass / 13.52 mm thick laminated toughened glass & 13.52 mm thick laminated heat strengthened glass with norton tape, silicon structural sealant and weather proofing sealant complete as shown in architectural GFC drawings/ as per approved shop drawings and the direction of Engineer- in-Charge.

Details of different type of glazing is as follow: -

a) 5.5 mm thick Single clear/float glass: - Providing and fixing 5.5 mm thick Single clear/float glass of approved make.

b) 5mm thick High performance toughened glass: Providing and fixing 5 mm thick High performance toughened glass of approved make (meeting the minimum glass specification mentioned below) with coating on face 2 in aluminium door, window, ventilator shutters etc. complete as per architectural drawings and the directions of engineer-in-charge. The glass shall be fixed with necessary EPDM rubber/neoprene gasket of the approved colour, make, size and shape with silicone sealant of neutral grade.

(1) Light Transmission - 44% to 56% (2) Reflection (Ext.) - 14 to 19% (3) Reflection (Int.) - 18 to 27% (4) Solar Factor - 0.46 to 0.50 (5) U value – 5.4 to 5.6 W/Sqm K.

c) 24 mm thick Double glazed insulating glass: Providing assembling supplying and fixing Double glazed insulating glass of size & shape as required & specified to aluminium door, window & structural glazing with norton tape, silicon structural sealant and weather proofing using weather proofing sealant (Dow-corning/Wacker or equivalent). The insulated glass comprising of an outer toughened (Heat strengthened) float/clear glass 6 mm thick of approved colour & shade with reflective coating on face 2 of approved colour & shade, an inner 6 mm thick clear float glass toughened separated by spacers to create 12 mm dehydrated air space and thermatically sealed by using double sealed organic sealant (priming sealant of thermoplastic), solvent free polyisobutylene which is applied on both sides of spacer, secondary sealant comprising of two component polysulphide in the right proportion for final outer seal including perforated channel for air spaces and complete processed with expertise of company authorized processor only or as directed by EIC, all complete for the minimum required performances given below, as per Architectural drawings, as per 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.

(1) Light Transmission - 47% to 50% (2) Reflection (Ext.) - 12% to 14% (3) Reflection (Int.) - 11 to 17% (4) Solar Factor - 0.27 to 0.28 (4) U value - 1.5 to 1.7 W/Sqm K.

d) 13.52 mm thick laminated high-performance glass for skylight etc as per GFC: Providing and fixing fixed glazing into skylights etc., with Laminated glass of approved quality of 13.52mm overall thickness with 1.52mm thick polyvinyl butyl sandwiched between heat strengthened glass of thickness 6 mm on both sides (one glass shall be 6 mm clear HS glass & one glass shall be 6 mm high performance HS glass). PVB Interlayer; colour shall be as per approved sample of the Architects. The glass shall be fixed with necessary EPDM rubber/neoprene gasket of approved colour, make, size and shape, with Norton tape, silicone structural / weather sealants of neutral grade. The Laminated glass shall be assembled in the factory/ workshop of the glass processor.etc. Complete as per architectural drawings and directions of engineer-in-charge

(1) Light Transmission - 42% to 45% (2) Reflection (Ext.) - 19% to 23% (3) Reflection (Int.) - 5 to 7% (4) Solar Factor -0.41 to 0.42 (4) U value -4.5 to 4.7 W/Sqm K.

e) 13.52 mm thick Laminated glass for spider glazing etc as per GFC: Providing and fixing in spider glazing item Laminated glass of approved quality of 13.52mm overall thickness with 1.52mm thick polyvinyl butyl sandwiched between toughened glass of thickness 6mm on both sides (one glass shall be 6 mm clear glass & one glass shall be 6 mm high performance glass) instead of 12 mm thick toughened glass as indicated in item. PVB Interlayer; colour shall be as per approved sample of the Architects. The glass shall be fixed with necessary EPDM rubber/neoprene gasket, PVC packing of approved colour, make, size and shape, with silicone sealant of neutral grade. The Laminated glass shall be assembled in the factory/ workshop of the glass processor.etc. Complete as per architectural drawings and directions of engineer-in-charge

(1) Light Transmission - 44% to 52% (2) Reflection (Ext.) - 14% to 19% (3) Reflection (Int.) - 18 to 22% (4) Solar Factor -0.42 to 0.45 (4) U value -5 to 5.4 W/Sqm K.

f) 31.52 mm thick Double glazed insulating glass for structural glazing etc as per GFC: Providing assembling supplying and fixing Double glazed insulating glass of size & shape as required & specified to aluminium door, window & structural glazing with norton tape, silicon structural sealant and weather proofing using weather proofing sealant (Dow-corning/Wacker or equivalent).The insulated glass comprising of an outer toughened laminated glass 13.52 mm thick (6mm clear toughened+1.52 PVB+ 6mm toughened high performance glass of approved colour& shade with reflective coating on face 2 of approved colour& shade), an inner 6 mm thick clear float glass toughened separated by spacers to create 12 mm dehydrated air space and thermatically sealed by using double sealed organic sealant (priming sealant of thermoplastic), solvent free polyisobutylene which is applied on both sides of spacer, secondary sealant comprising of two component polysulphide in the right proportion for final outer seal including perforated channel for air spaces and complete processed with expertise of company authorized processor only or as directed by EIC, all complete for the minimum required performances given below, as per Architectural drawings, as per approved shop drawings, as specified and as directed by Engineer-in-Charge. The IGUs shall be assembled in the factory/ workshop of the glass processor.

(1) Light Transmission - 46% to 48% (2) Reflection (Ext.) - 12% to 13% (3) Reflection (Int.) - 11 to 16% (4) Solar Factor -0.25 to 0.27 (4) U value -1.5 to 1.6 W/Sqm K.

Installation: -

The glass shall be cut to exact size, toughened and brought to site for installation. The glass panes shall be so cut that it fits slightly loose in the frames. Glazing shall be provided on the outside of the frame unless otherwise specified. Before fixing the glass all joints and glazing pockets to be cleaned by removing all foreign matter and

contaminants such as grease, oil, dust, water, frost, surface dirt or glazing compounds and protective coatings. Fixing of glass panes may be done with Aluminium beading / section as shown in structural glazing detail. Areas adjacent to joints shall be masked to ensure neat sealant lines. Masking tape shall not be allowed to touch clean surfaces to which the silicone sealant is to adhere. Tooling shall be completed in one continuous stroke immediately after sealant application and before a skin forms. Masking tape shall be removed immediately after tooling. Installation of backer rod of appropriate size and application of silicone sealant in a continuous operation using a positive pressure adequate to properly fill and seal the joint. The silicone sealant shall be tooled with light pressure to spread the sealant against backing material and the joint surfaces before a skin forms. A tool with convex profile shall be used to keep the sealant within the joint. Soap or water shall not be used as a tooling aid. All the glass work shall be installed by a company Authorized/Trained/Reffered system integrator only or as decided by Engineer in Charge.

SAMPLES / SHOP DRAWINGS

The contractor shall organize to submit samples & shop drawings well in advance for approval.

SEMI UNITIZED STRUCTURAL CURTAIN GLAZING SYSTEM WITH PRESSURE PLATE & CAP:

Designing, fabricating, testing, installing and fixing in position structural glazing and its suitable glazing cleaning/maintenance system for all heights and all levels is included in scope of contractor.

Structural Glazing shall be designed as per BIS code IS-875 Part III / EN 12210 for required wind pressure. Structural analysis & design and preparation of shop drawings for the specified design loads conforming to IS 875 part III (the system must pass the proof test at 1.5 times design wind pressure without any failure), including functional design of the aluminum 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) The contractor must design the Structural Glazing as per the prevalent site conditions and building profiles and the Structural Glazing should be structurally safe. The system should have already been tested/accredited by an international independent testing laboratory. The system should comply with an Air infiltration requirement of ± 600 Pa when tested in accordance with ASTM E283 / EN 12207 133, Static and Dynamic water penetration of 720 Pa in accordance with ASTM E331.

The work of Structural Glazing shall include the designing and fixing Mullions & Transoms to the structure through adequately designed galvanized MS brackets, providing and fixing glass of approved quality & spec. with Aluminum sections using structural silicon sealant of approved quality including all Aluminum sub frames wherever necessary The transom should be shorter than mullion by 1mm at the back face of the mullion. Gap between the transom and mullion surface at intersection would not be acceptable. The system shall also include sealing the complete glazing

and perimeter channel with weather sealant to prevent water penetration as per relevant specifications etc. Complete as per detailed drawings & approved shop drawings. A complete drainage system to be incorporated in the design in the unlikely event that water penetrates the pressure seal.

The contractor must provide detailed design & drawings of the system indicating individual profiles and also details of any other profiles that may be used including dimensions, wall thickness etc., for approval by the Engineer-in-Charge.

Specification for Materials used for Curtain Wall

(1) Glazing: as specified in drawing.

(2) Framing system: Extruded Aluminum sections shall be specially designed and shall be of 6063/6060 T6 alloy. All exposed profiles should be powder coated to a minimum of 60 microns. All anchor fasteners to be made of SS 304 grade. All shims to be capable of transferring the load evenly and made of a suitable material (Teflon etc.) capable of lasting the life span of the system including all miscellaneous items such as peripheral sealants, backer rods, flashing, fasteners, brackets etc. Aluminum extruded sections along with hardware & accessories should be supplied by Approved system companies for all types of articles like, mullions, transoms, gaskets, hardware etc.

(3) Sealant: Silicon sealant structural grade and weather grade shall be of approved make as per the design requirement.

(4) Non-corrosive galvanized brackets of approved design. Galvanizing to be done conforming to IS: 4759-1996 up to 610 gms. Per Sqm. i.e. 80-90-micron thickness. Shims of various thickness to adjust the beam level/ line variations fixed with SS 316 Grade dash fasteners of approved make min. 12mm dia. 100 mm long.

Preliminary Requirements

(i) The contractor shall design, fabricate, deliver, install, test and guarantee all construction necessary to provide a complete curtain wall system for the proposed building, all in conformity with the drawings as shown

(ii) Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the drawing

(iii) The curtain wall system shall also include the following activities:

- Metal frames, glass glazing, spandrels, ventilators, finish hardware copings, metal closure, windows etc.
- All anchors attachments, reinforcement and steel reinforcing for the systems required for the complete installations.
- All copings and closure and metal cladding to complete the system.
- All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system. Gaps up to 10 mm between the peripheral aluminum member and masonry / R.C.C. / Stone shall be sealed by inserting Backer Rod and weather silicon sealant: wherever the gaps are more than 10 mm the same shall be sealed by providing and fixing 1.5 mm thick

Aluminum sheet flashings bent to required profile as per approved design and duly Anodized/Powder coated in approved color.

- Isolation of dissimilar metals and moving parts.
- Anticorrosive treatment on all metals used in the system.

Deflection Criteria: - For mullions: for Single height glazing, Span/175 or 19 mm, whichever is less. And for Double height glazing For spans up to 4110 mm, same as single height; and for spans above 4110 mm, the same shall be $(\text{span}/240)+6.35$ mm.

For transoms: i. Span/500 or 3 mm, whichever is the least for dead load and Span/175 or 19 mm, whichever is the least for wind load. Deflection at the centre of the glass: Monolithic glass Shortest span/60 or 19 mm, whichever is the least and Double glazed unit Shortest span/90 or 19 mm, whichever is the least and Deflection at edge of the glass Shall be limited to 15mm.

- The transom should overlap the mullion with an EPDM separator. The screws for transom should not affect the transom gaskets. The system should have a continuous base transom with suitable continuous EPDM base gasket.

(iv) The contractor shall also be responsible for providing the following:

- Engineering proposal, shop drawings, engineering data and structural calculations in connection with the design of the curtain wall system.
- Mock-ups, samples and test units.
- Performance testing of the curtain wall framing and glazing assembly.
- Co-ordination with the work of other trade.
- Protection during construction.
- All final exterior and interior cleaning and finishing of the curtain wall system.
- As built record drawings and photographs.
- Audit/inspection reports by principal system Supplier Company
- Guarantees and warranties.
- All hoisting, scaffolding, staging and temporary services.
- Conceptualizing and design of a suitable maintenance system for curtain glazing.

(v) The water tightness and structural stability of the whole curtain wall system is the prime responsibility of the contractor. Any defect or leakage found within the guarantee period shall be sealed and made good at the risk and cost of the contractor.

(vi) The curtain wall system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects, specific details should be designed to accommodate thermal and building movements.

Design Requirements

- The basic design and architectural requirements shall consist of the size of window, net glass area, ventilator, configuration of windows and spandrels to be retained. However, the contractor may propose alternatives on the construction details provided that all basic functional and architectural requirements are fulfilled.
- Curtain wall shall comply with all government codes and regulations, building bye-laws, if any.
- All curtain walling, individual aluminum and glass components and all completed work shall be designed and erected to comply with the following requirements.

Testing

The following performance test are to be conducted on structural glazing system if area of structural glazing exceeds 2500 Sqm from the certified laboratories accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories), Department of Science & Technologies, India.

The NIT approving authority will decide the necessity of testing on the basis of cost of the work, cost of the test and importance of the work. Performance Testing of Structural glazing system Tests to be conducted in the 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.

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
2. Static Water Penetration Test. (50pa to 1500p) as per ASTM E- 331-09 testing method for a range up to 2000 ml.
3. Dynamic Water Penetration (50pa to 1500pa) as per AAMA 501.01- 05 testing method for a range upto 2000 ml
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.
5. Seismic Movement Test (upto 30 mm) as per AAMA 501.4- 09 testing method for Qualitative test, Tests to be conducted on site.
6. Onsite Test for Water Leakage for a pressure range 50 kpa to 240 kpa (35psi) upto 2000 ml

SPIDER GLAZING:

Designing, fabricating, testing, installing and fixing in position spider glazing for all heights and all levels is included in scope of contractor

Suspended Spider Glazing system shall be designed to withstand the wind pressure as per IS 875 (Part-III). The Suspended System held with Spider Fittings of SS-316 Grade Steel of approved manufacturer with Laminated glass of approved quality (Laminated glass of 13.52mm overall thickness with 1.52mm thick polyvinyl butyl layer sandwiched between toughened glass of thickness 6 mm on both sides. PVB Interlayer; colour shall be as per approved sample of the Architects.) held together with SS- 316 Grade Stainless Steel Spider & bolt assembly with laminated glass fins 21 mm thick. The Glass fins and glass panel assembly shall be connected to Slab/ beams by means of SS- 316 Grade stainless steel brackets & Anchor bolts and at the bottom using SS channel of 50x25x2mm using fastener & anchor bolts, non staining weather sealants of approved make, Teflon/ nylon bushes and separators to prevent bi-metallic contact, all complete to perform as per specification and approved drawings. The complete system to be designed to accommodate thermal expansion & seismic movements etc. The joints between glass panels (6 to 8 mm) and gaps at the perimeter & in U channel of the assembly to be filled with non staining weather sealant, so as to make the entire system fully water proof & dust proof. Spider glazing item includes all design, Engineering and shop drawing including approval from structural designer, labour, T&P, scaffolding, other incidental charges including wastage, enabling temporary services all fitting fixers nut bolts, washer, Buffer plates, fastener, anchors, SS channel laminated glass etc. all complete. Shop drawings shall be submitted for approval from the Engineer in charge before the execution of work.

SKYLIGHTS GLAZING:

Base frame of all skylights shall be M.S tubular frame of approved make & size as per architectural GFC drawings fixed with the help of Stainless steel grade 304 anchor fastener on concrete surface. All MS frames shall be painted with polyurethane paint over two coat of Surface Tolerant Epoxy primer after surface preparation as per manufacturer's specification. Over the MS frame work 13.52 mm thick laminated glass shall be fixed with the help of aluminium sections, profiles, trim section, caps etc. of size as mentioned in architectural GFC drawing. Junctions of laminated glass shall be covered with aluminium capping profile / section as shown & of size mentioned in GFC drawing including backer rod & weather sealant to seal the junctions complete as directed by Engineer-in-Charge. Shop drawings shall be submitted for approval from the architects before the execution of work.

STRUCTURE GLAZING:

ALUMINIUM EXTRUDED TUBULAR AND OTHER ALUMINIUM SECTIONS

Fixing of 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 including material such as cleats, sleeves, screws etc. necessary for fabrication of extruded aluminium frame work.

IGU PANELS IN THE CURTAIN GLAZING

Designing, 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 & 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 aluminum 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 serrated M.S. hot dip galvanised / Aluminium alloy of 6005 T5 brackets of required sizes, sections and profiles etc. to accommodate 3 Dimentional 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 seperator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers.
- (c) 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.
- (d) 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.
- (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. Also include all inputs of designing, 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. 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. Above shall include provision of 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.

Note:-2. The following performance test are to be conducted on structural glazing system if area of structural glazing exceeds 2500 Sqm from the certified laboratories accredited by NABL(National Accreditation Board for Testing and Calibration Laboratories), Department of Science & Technologies, India. Cost of testing is payable separately.

The NIT approving authority will decide the necessity of testing on the basis of cost of the work, cost of the test and importance of the work. Performance Testing of Structural glazing system Tests to be conducted in the 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.

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

2. Static Water Penetration Test. (50pa to 1500p) as per ASTM E- 331-09 testing method for a range up to 2000 ml.

3. Dynamic Water Penetration (50pa to 1500pa) as per AAMA 501.01- 05 testing method for a range upto 2000 ml

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

5. Seismic Movement Test (upto 30 mm) as per AAMA 501.4- 09 testing method for Qualitative test, Tests to be conducted on site.

6. Onsite Test for Water Leakage for a pressure range 50 kpa to 240 kpa (35psi) upto 2000 ml

VISION GLASS PANELS

Vision glass panels (IGUs) 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 strengthned clear float glass 6mm thick, spacer tube 12mm wide, dessicants, 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. 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/m² degree K etc. The properties of performance glass shall be decided by technical sanctioning authority as per the site requirement.

Openable side / top hung vision glass panels (IGUs) including providing and supplying at site all accessories and hardwares 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.

ACOUSTICAL WALL PANELLING & ACOUSTICS DOOR

ACOUSTICAL WALL PANELLING

The Contractor shall carry out acoustical study by engaging acoustical consultant (at his own cost) of the Meeting Halls/Lecture halls/Conference hall taking account of drawings and should mention to E.I.C before starting of work if the drawings are good enough or not to achieve good acoustics of Meeting Halls/Lecturehalls/Conference hall . The contractor shall also suggest ways to achieve desired values of various parameters for good acoustics to E.I.C for which nothing will be paid extra.

Post construction the contractor has to carry out acoustical study from an independent agency/acoustical consultant to verify the various acoustical parameters achieved or not. In case of non-achievement of these parameters on account of faulty execution, the modifications will have to be carried out by the contractor at no extra cost.

TYPE P1: OAK / CEDAR VENEERED PLY PANELLING

Materials: -

Wood: - 4mm thick Oak / Cedar veneered ply & 6mm thick water proof marine ply, Steel Screws & dash fasteners: - As specified or as per approved sample, MS tube, MS Angles, Flats etc, Steel Primer, Enamel Paint, Wood Polish: - As specified or as per approved sample.

Installation: - MS angle 50x50x5 supports / cleats of suitable size fixed to wall surface with dashfasteners of 8 mm dia, 75 mm long bolt as shown in drawing. Tubular frame work shall comprise of 50x50x1.6mm hollow MS tube, fixed away from the wall surface by MS angle supports/cleats of suitable size. The hollow MS tubes to be mounted in a grid pattern with spacing @ 400mm / 1000mm centre to centre (horizontally & vertically) or at required spacing near opening, with necessary fixing / welding at junctions and fixing the frame to wall with steel dash fasteners of 8 mm dia, 75 mm long bolt, including providing with two coats of approved steel primer etc. The tubular framework to have welded connections, minimum 20mm fillet weld on each side.

Providing and fixing 4mm thick Oak / Cedar veneered ply (Kitply, Greenply, Century or equivalent) on 6mm thick water proof marine ply, phenolic bonded (Kitply,

Greenply, Century or equivalent) and the surface finished with moulded Oak / Cedar beading of 15 x 25mm in pattern as per drawing with 38mm long self tapping and self drilling steel screws on framework. Entire work to be done as per drawing, specifications and direction of Engineer-in-charge. To be wax polished in natural colour.

TYPE P2: OAK / CEDAR WOOD SLAT PANELLING WITHOUT INSULATION

Materials: -

Wood: - First class Oak / Cedar Wood, 6 mm thick marine ply, Steel Screws & dash fasteners: - As specified or as per approved sample, MS tube, MS Angles, Flats etc, Steel Primer, Enamel Paint, Wood Polish, Glass wool, Black dyed jute upholstery fabric (not hessian): - As specified or as per approved sample.

Installation: - MS angle 50x50x5 supports / cleats of suitable size fixed to wall surface with dashfasteners of 8 mm dia, 75 mm long bolt as shown in drawing. Tubular framework shall comprise of 50x50x1.6mm hollow MS tube, fixed away from the wall surface by MS angle supports/cleats of suitable size. The hollow MS tubes to be mounted in a grid pattern with spacing @ 400mm / 1000mm centre to centre (horizontally & vertically) or at required spacing near opening, with necessary fixing / welding at junctions and fixing the frame to wall with steel dash fasteners of 8 mm dia, 75 mm long bolt, including providing with two coats of approved steel primer etc. The tubular framework to have welded connections, minimum 20mm fillet weld on each side.

In order to minimize visibility of screws panel of size as per drawing supported on MS flats 20 x 6 mm at top & bottom are to be made with 80 x 12 mm & 32.5 x 12 mm thick timber slats with a groove of 15mm between slats in pattern as per drawing with stainless steel screws from the rear. MS flats shall be painted with two coats of enamel paint over two coats of approved steel primer. Timber panels shall be preferably made of timber of large width; the minimum width and thickness of the panel shall be same as specified in the drawings. The grains of timber panels shall be sawn in the directions of grains & shall run along the longer dimensions of the panels. All panels shall be of the same species of timber unless otherwise specified. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the required dimensions.

These timber slat panels shall be fixed to the tubular frame as per pattern shown in drawing with self tapping stainless screws. The slats to be backed with black dyed jute upholstery fabric (not hessian) fix over 6 mm thick marine ply. Finally, the slats shall be wax polished after wood filler and sand papering to a smooth finish in its natural colour complete as per drawing, specifications and direction of Engineer-in-Charge.

TYPE P3: OAK / CEDAR WOOD SLAT PANELLING WITH INSULATION

Materials: -

Wood: - First class Oak / Cedar Wood, Steel Screws & dash fasteners: - As specified or as per approved sample, MS tube, MS Angles, Flats etc, Steel Primer, Enamel Paint,

Wood Polish, Glass wool, Black dyed jute upholstery fabric (not hessian): - As specified or as per approved sample

Installation: - MS angle 50x50x5 supports / cleats of suitable size fixed to wall surface with dash fasteners of 8 mm dia, 75 mm long bolt as shown in drawing. Tubular frame work shall comprise of 50x50x1.6mm hollow MS tube, fixed away from the wall surface by MS angle supports/cleats of suitable size. The hollow MS tubes to be mounted in a grid pattern with spacing @ 400mm / 1000mm centre to centre (horizontally & vertically) or at required spacing near opening, with necessary fixing / welding at junctions and fixing the frame to wall with steel dash fasteners of 8 mm dia, 75 mm long bolt, including providing with two coats of approved steel primer etc. The tubular framework to have welded connections, minimum 20mm fillet weld on each side.

In order to minimize visibility of screws panels of size as per drawing supported on MS flats 20 x 6 mm at top & bottom are to be made with 80 x 12 mm & 32.5 x 12 mm thick timber slats with a groove of 15mm between slats in pattern as per drawing with stainless steel screws from the rear. MS flats shall be painted with two coats of enamel paint over two coats of approved steel primer. Timber panels shall be preferably made of timber of large width; the minimum width and thickness of the panel shall be same as specified in the drawings. The grains of timber panels shall be sawn in the directions of grains & shall run along the longer dimensions of the panels. All panels shall be of the same species of timber unless otherwise specified. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the required dimensions.

These timber slat panels shall be fixed to the tubular frame as per pattern shown in drawing with self tapping stainless screws. The slats to be backed with black dyed jute upholstery fabric (not hessian) held on 24G x 10mm wire mesh and 50mm thick resin bonded glass wool (24 kg/m³) cut to size and inserted in GI framework held on 24Gx12 GI wire netting. Finally the slats shall be wax polished after wood filler and sand papering to a smooth finish in its natural colour complete as per drawing, specifications and direction of Engineer-in-Charge.

TYPE P4: OAK / CEDAR WOOD SLAT PANELLING WITH INSULATION & MINIMUM 50 MM AIR GAP

Materials: -

Wood: - First class Oak / Cedar Wood, Steel Screws & dash fasteners: - As specified or as per approved sample, MS tube, MS Angles, Flats etc, Steel Primer, Enamel Paint, Wood Polish, Glass wool, Black dyed jute upholstery fabric (not hessian): - As specified or as per approved sample

Installation: - MS angle 50x50x5 supports / cleats of suitable size fixed to wall surface with dash fasteners of 8 mm dia, 75 mm long bolt as shown in drawing **(in such a manner to get a minimum clear space / air gap of 50 mm thick between the wall & paneling)**. Tubular frame work shall comprise of 50x50x1.6mm hollow MS tube, fixed away from the wall surface by MS angle supports/cleats of suitable size. The hollow MS tubes to be mounted in a grid pattern with spacing @ 400mm / 1000mm

centre to centre (horizontally & vertically) or at required spacing near opening, with necessary fixing / welding at junctions and fixing the frame to wall with steel dash fasteners of 8 mm dia, 75 mm long bolt, including providing with two coats of approved steel primer etc. The tubular framework to have welded connections, minimum 20mm fillet weld on each side.

In order to minimize visibility of screws panels of size as per drawing supported on MS flats 20 x 6 mm at top & bottom are to be made with 80 x 12 mm & 32.5 x 12 mm thick timber slats with a groove of 15mm between slats in pattern as per drawing with stainless steel screws from the rear. MS flats shall be painted with two coats of enamel paint over two coats of approved steel primer. Timber panels shall be preferably made of timber of large width; the minimum width and thickness of the panel shall be same as specified in the drawings. The grains of timber panels shall be sawn in the directions of grains & shall run along the longer dimensions of the panels. All panels shall be of the same species of timber unless otherwise specified. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the required dimensions.

These timber slat panels shall be fixed to the tubular frame as per pattern shown in drawing with self tapping stainless screws. The slats to be backed with black dyed jute upholstery fabric (not hessian) held on 24G x 10mm wire mesh and 50mm thick resin bonded glass wool (24 kg/m³) cut to size and inserted in GI framework held on 24Gx12 GI wire netting. Finally the slats shall be wax polished after wood filler and sand papering to a smooth finish in its natural colour complete as per drawing, specifications and direction of Engineer-in-Charge.

Automatic Hermetically Sealed Sliding Door

Door and Frames: Hermetically Sealed Sliding Automatic Door inside OT: Size 1500mm x 2100mm with vision panels, 300mm X 300 mm. To maintain sterility and the correct air pressure in the room, all doors into and out should be of the sliding, hermetically sealing type. Track system and door blade guide system: Automated or a Manual Hand operated hermetically sealing sliding main door on OT, of appropriate size, 2100mm (ht.) x 1000 / 1500 / 1800mm (wd.). As required. Door Leaf Strength of leaf core: 40mm (33mm tubular chipboard (core) + 3mm MDF (medium-density fibreboard) on both sides + 0,8mm HPL (Steripanel High Pressure Laminate) on both sites). Circumferential profile: Anodized aluminium profile, circumferential 56 mm, V-shaped in the bottom area towards door lead on ground lobes. Surface: 0.8 mm HPL-laminate on 3 mm MDF-board as carrier material; depending on the chosen material a free passage of 1.15 m or more may require a seam in the laminate. Sealing: Rubber gaskets embedded in the door leaves press against the frame and the door, providing a hermetic sealing of the door. Rail System Guide rail: Anodized aluminium profile with two countersunk slots at 42° for carrying wheel position in closed condition. Carrying wheels: Ball bearing with duoplastic rolls. Covering: Rounded covering of extruded anodized aluminium. Ground Rail: Duoplastic lead lobes on bottom running rail. Operation Handle: Bilateral (inside/outside) stainless steel lever arm handle with integrated return spring to neutral position. Frame HPL-system frame: HPL-coated embrasure board with circumferential aluminium corner protection profiles for arbitrary wall strengths. Closed frame- steel: Closed steel frame with additional

aluminium corner protection profiles (for sealing the operation side of the door). Closed frame- stainless steel: Stainless steel frame, steel grade 1.4301, polished 240 grain, with additional stainless steel corner profiles (for sealing the operation side of the door). Window: Integrated 300 x 300mm window, mounted flush with the adjacent area of the leaf. Automated drive: Process-controlled automated drive for the most diverging kinds of activation. Lock: Deadbolt lock, prepared for Euro norm-profile cylinder. Electric lock: Electric lock, 24 V for activation through code locks, switches, key switches, or reciprocal interlocking doors. Acoustic Value: The acoustic value of the door is about 28dB. Weight of the door and door blade: Door leaf 1560 x 2105 about 40Kg. Weight of the door and door blade: Door leaf 1060 x 2105 about 28-30Kg. Canopy about 15 to 20 Kg (depending of the door). Power requirement: 230V alternating current 50Hz. The opening-distances are controlled completely step less. It can be adjusted (according to the switches). Speed of the door adjustable: The speed is adjustable in 5%-steps (opening and closing speed is adjustable separately). It is adjustable from 0,1m/sec. to 0,8m/sec. The time the door stays open is adjustable up to 30 sec. (standard is 8 sec). Foot Switch inside and outside. Elbow Switch inside and outside. Movement Sensors inside and outside. Door profile inside and outside.

ACOUSTICS DOOR

Providing & fixing of 75mm thick Nonmetallic, Asbestos Free Accoustic cum fire/smoke door of 120 minutes fire rating, conforming to BS: 476 part 22 IS: 3614 part -II, suitable to achieve minimum 32-35db, sound reducing properties suitable for fixing in wooden door frame of suitable section 145X75 mm made out of **2nd Class Teakwood** and the shutter comprising of 2nos 12 mm thick non -combustible fire rated boards, sandwiching **45 mm thick** fire resistant & accoustic insulation filler. The shutter is faced with 4mm thick matching wood veneered ply facing on both sides of door in approved make, colour & shade and wooden lipping all around the shutter with heat activated intumescent fire seal strip of size 20x4mm on all sides except bottom (for smoke sealing) both in frame & shutter. The door shall be fixed with Acoustics seals for sound reduction properties. The shutter is fitted with the frame with the help of SS ball bearing hinges of size 100x89x3mm (Minimum 04 nos. per leaf). The rate includes providing and fixing of Accoustic seals as per the details, SS 304 pull handle of size 600mm, Tower bolts, Anchor/Dash fasteners, fire rated hardware i.e SS hinges, door closers, Satin Stainless steel 304 grade mortice dead lock etc. Painting/polishing all as per drawing and direction of Engineer-in-charge. This item also includes providing & fixing of 4 nos. of Galvanized Iron Hold fasts 40mm x 5mm flat 300 mm long including fixing to frame with 10 mm dia. bolt, nut and wooden plug and embedding in cement concrete 1 : 2 : 4 block of size 30 x 10 x 15 cm.

TOILET CUBICLE SYSTEM

Supply and installation of Toilet cubicle system of width and depth as per manufacturer's specifications / Architectural drawings. Toilet cubicle system consists of two parts – pilasters & doors and intermediate panels. All Intermediate panels shall be of 18 mm thick solid compact laminate as one continuous panel without any joints and pilasters & Doors shall be made of solid compact laminate 18 mm thick with edges chamfered. Cubicle height to be maximum 2100 mm. (Height is including 110 gap mm

from bottom) & Door standard width is 600 mm. The product should have Green Guard & IGBC Certificate.

Made from solid grade compact high-pressure laminate as per IS:2046 manufactured under high specific pressure > 5 MPa and temperature >120°C with bunch of kraft papers impregnated with thermosetting phenolic resin and decorative papers made of Alpha cellulose fiber impregnated with thermosetting melamine resin which provide superior scratch, abrasion, heat, chemical, impact, graffiti & moisture resistance along with anti-bacterial properties. Panels have a black core that when machined, presents a distinctive black edge. Top surface on both sides is melamine coated which is scratch and impact resistant. Panel thickness 18 mm. Design no. as specified by Arch. / Engr. in suede finish. Size of panels to be as per drawing.

All pilasters are to be supported by stainless steel "L" bracket with floor anchor bolt, which is concealed with stainless steel flat box-up of height 100 mm. The stainless-steel box-up shoe is in SS Grade 316. Fixing of intermediate panels to the wall shall be with stainless steel grade -304 U channel section fixed into the wall with SS-304 screw inserts.

HARDWARE & ACCESSORIES

- (1) Door Knob in Grade-304
- (2) Spring Loaded butt Hinges in Grade-304 with cover
- (3) Thumb turn lockset with Occupancy indicator in Grade-304
- (4) Coat hook with rubber door stopper in Grade-304
- (5) Stainless steel "U" & "F" channel & " L " plate all in Grade-304
- (6) Stainless steel shoe box leg 18 mm in Grade-316
- (7) SS screw 304 grade with P.V.C wall plug
- (8) Rubber lining for groove

Installation: As per detailed Architectural Drawings, Manufacturer Technical Specification and as directed by Engineer-in-charge.

All the material supplied and installed shall be as per the description and specifications in the item. The shop drawing showing Detailed plans and elevations, details of framing members, anchoring methods, clearances, hardware, and accessories for individual toilets as per site condition shall be submitted by the contractor for obtaining approval of the Engineer-in-charge before start of work. the work to be done authorized/Trained installer of manufacturer or as decided by E.I.C

STEEL FIRE DOORS (INSULATED & NON-INSULATED)

Fire Rated Insulated Doors

FIRE RESISTANT DOOR FRAME

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/m²) suitable for mounting 120 min Fire Rated Glazed Door Shutters. The frame shall be filled with Mineral wool Insulation having density min 96Kg/m³. 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 a approved fire-resistant primer or Powder coating of not less than 30 microns in desired shade as per the directions of Engineer - in- charge.

GLAZED FIRE-RESISTANT DOOR SHUTTERS

Providing and fixing 60 mm thick glazed fire resistant door shutters of 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, 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/m²) duly filled mineral wool insulation having density min 96 kg/ m³ 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.

GLAZING

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/m²) 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 microns 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-incharge with 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. The maximum glazing size shall not be more than 1100x2200 mm (w x h) or 2.42 sqm.

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.

All hardware fittings should be minimum two hour fire rating.

Fire Rated Un-Insulated Doors

Providing and fixing of Hollow metal Un-Insulated fire rated doors as per IS 3614 part-1, for stability and integrity. Pressed galvanized steel confirming to IS 277 with the

following specification. Recommended fire door shall be tested to IS 3614 part 2 / ISO 834-1 Part 1 / BS476 Part 20 & 22, CBRI / Cerifire or third party certified or equivalent lab, for maximum rating of 120mins, in latched /unlatched condition (if used with deadbolts and pull handles). Labeled doors with certification shall be with vision glass as a part of complete assembly. Manufacturer test certificate shall cover doors both single and double leaf and all doors supplied shall be within the tested specimen, deviation in specification and sheet thickness other than what is mentioned in the test certificates are not allowed. Proper label confirming the type of door and the hourly rating is mandatory from Approved manufacturer or equivalent.

Size of door frame and shutter shall be as per the manufactures specification with 2 Hrs fire rating. Door frame shall be single rebate grooved profile of size 125 x 60mm made out of 1.60mm (16gauge) minimum thick galvanized steel sheet. Frames shall be mitered and field assembled with self-tabs. Frames to have in build 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 bracket and anchor fasteners for installation on a finished plastered masonry wall opening including necessary 3mm/4.8 mm thick steel hinge reinforcement, 1.2 mm thick steel lock strike reinforcement with tapped holes welded to the frame and 1.2mm thick mortar guard at the back of all hardware cutout in the frame. The frame will have a provision of G.I. Anchor fastners 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 approved Size.. The frames should be zinc phosphated and finished with minimum 50 micron Thermosetting Powder Coating of approved colour and shade / finish in desired RAL Shade. Frames shall be filled with fire rated puff.

Door leaf shall be 46mm thick fully flush double skin door, Un-insulated with or without vision lite as per GFC drawing. Door leaf shall be manufactured from 1.2mm (18gauge) minimum thick galvanized steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be structural small cell resin bonded Honey comb craft paper treated with appropriate fire retardent paint. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges should be interlocked with a bending radius of 1.4mm. For pair of doors integrated astragals has to be provided on the meeting stile for both active and inactive leaf. Vision lite wherever applicable should be provided as per manufacturer's recommendation with a clip-on arrangement. The glass should be 6mm clear borosilicate fire rated glass of relevant rating of the door. The shutters should be zinc phosphated and finished with minimum 50 micron Thermosetting Powder Coating of approved colour and shade / finish in desired RAL Shade.

All doors and frames should be zinc phosphated and finished with minimum 50 micron Thermosetting Powder Coating of approved colour and shade / finish in desired RAL Shade and shall have passed minimum 500 hours of salt spray test.

Item shall include supply and installation of door and hardware as a complete assembly as mentioned in the door and hardware schedule. Once frame installed should be filled with PUF as recommended by the manufacturer.

120Mins Fire Rated Door Single/double leaf of size as mentioned in GFC Drawing with vision panel 200x300mm with hardware set stainless steel grade 304 ball bearing butt hinges, stainless steel grade 304 pull handle of 300mm long on both side, mortise dead lock with both side cylinders, Fire rated surface mounted door closer, groove seal for smoke, all hardware are as per List of preferred makes & inclusive of PUFF Grouting. All hardware fittings should be minimum two hour fire rating.

MS STRUCTURAL STEEL WORK: -

T-IRON FRAMES

For Doors, Windows and Ventilators of mild steel Tee-sections, joints mitred and welded, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer. Fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size).

PRESSED STEEL DOOR FRAMES

Pressed Steel Door Frames conforming to IS: 4351, manufactured from commercial mild steel sheet of 1.60 mm thickness, including hinges, jamb, lock jamb, bead and if required angle threshold of mild steel angle of section 50x25 mm, or base ties of 1.60 mm, pressed mild steel welded or rigidly fixed together by mechanical means, including M.S. pressed butt hinges 2.5 mm thick with mortar guards, lock strike-plate and shock absorbers as specified and applying a coat of approved steel primer after pre-treatment of the surface as directed by Engineer-in-charge:

Profile B - Fixing with adjustable lugs with split end tail to each jamb metre 417.60

Profile C - Fixing with adjustable lugs with split end tail to each jamb metre 444.35

Profile E - Fixing with adjustable lugs with split end tail to each jamb metre 484.50

M.S. TUBULAR FRAMES

M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer. Fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size)

STRUCTURAL STEEL

Structural steel of grade E250 confirming to IS2062 shall be used for M.S. Steel ladder, M.S. Hand rail, M.S. Insert Plates / Base / gusset / stiffener plates as per Architectural / Structural drawings. M.S. Tube (Pipe / square / rectangular) sections shall be of grade E310 for Pipes / E350 for RHS & SHS shall be used for Architectural Pergolas, Façade members if any as per corresponding Architectural / Structural drawings.

MS support (angle, tube, channel, etc.) at wall / ceiling for services line (Plumbing, Electrical, HVAC, etc.) shall be provided as per approved shop drawing, design and direction of E-I-C. MS supports to be fixed with 100x8mm anchor fasteners in concrete / hold fast with grade of concrete as shown in drawing.

Mild steel round holding down bolts with nuts and washer plates shall be as per GFC drawing.

MS Steel railing shall be provided as per details, locations shown in GFC drawing. MS works in Monkey ladder for O.H.T.machine Room terrace, Mumty terrace & Plumbing shaft as per architectural drawing.

Library & Data centre : Fire Escape staircase shall be made with MS structural steel with MS railing as per detail given in GFC structural / Architectural drawing.

Architectural Pergolas shall be made at various locations as shown in architectural drawing with M.S. Tubular (Pipe / square / rectangular) sections of sizes & design as per detailed GFC drawing.

M.S. Screen with gates shall be provided at various locations as per details provided in the architectural GFC detailed drawings using M.S. tubular section, solid M.S. square bar , M.S. plates etc as required. The gate shall be fixed with MS heavy duty hinges, all hardware such as heavy duty MS Aldrops, tower bolts etc, as shown in GFC drawings or as directed by E-I-C / Architect.

MS support (angle, tube, channel, etc.) at wall / ceiling for services line (Plumbing, Electrical, HVAC, etc.) shall be provided as per approved shop drawing, design and direction of E-I-C. MS supports to be fixed with 100x8mm anchor fasteners in concrete or as shown in drawing

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 stringers, treads, landings etc. of stair cases, including use of chequered plate wherever required, all complete.

All MS/Structural Steel works shall be finished with acrylic aliphatic polyurethane paint as per specification given

General specifications/points to be followed by Contractor for doing MS / Structural Steel work :-

Material Report: Prior to start of delivery of structural steel required for contractor shall submit the following to the Engineer-In-Charge for review.

a) Certified copies of mill test reports including chemical analysis and physical properties as required by the applicable Indian Standards for each consignment of steel.

Shop/Fabrication Drawings: Before commencement of any structural steel fabrication work, the contractor shall submit the following to the Engineer-In-Charge for his approval:

a) Fabrication drawings including details of connections.

b) Assembly, erection and installation drawings and manuals indicating the sequence of work, welding and bolting procedure to be used. Cambers for trusses and large span girders shall be shown.

c) For composite construction the details and calculation of details and calculation of false work and forms supporting the concrete work in steel structure shall be submitted.

d) The drawings prepared by the contractor and all subsequent revisions etc. shall be at the cost of contractor for which no separate payment will be made.

Handling & Storage

Structural steel shall be stored out of mud and dirt and proper drainage of the storage area shall be provided. Protect from damage or spoiling by adjacent construction operations.

Fabricated steel shall not be handled until the paint has thoroughly dried. Care shall be taken to avoid paint abrasions and other damage. Steel work shall be transported in the largest practical lengths and in such a way as not to overstress the fabricated sections. All pieces bent or otherwise damaged shall be replaced by the Contractor at his own cost.

As far as practicable, stacking of fabricated steel shall be done in sequence of erection. But heavy members shall not be stacked on top of the light ones.

Cutting

Gas Cutting shall normally be permitted for mild steel only. Gas cutting of high tensile steel may be permitted provided special care is taken to leave sufficient metal to be removed by matching so that nil metal that has been hardened by flame is removed. Gas cutting shall preferably be done by machine, Hand flame cutting; may only be permitted subject to the approval of the Engineer-In-Charge. Gas cut edges shall be free of gouge. Any gouges that remain after cutting shall be removed by grinding.

For tubular construction cutting of the pipe and preparation of joint surface shall be done in a neat manner for a good fit up. The ends of the tubes may be flattened or otherwise framed for connections provided that the methods adopted for such flattening do not injure the material. The change of section shall be gradual.

Holing

Holes shall preferably be done by drilling. Punching shall not be permitted unless previously approved by the Engineer-In-Charge. In any case, punching of holes in materials having a thickness in excess of the connector diameter or in the materials thicker than 16mm shall not be permitted. Where punching is permitted the holes shall be punched 3 mm less in diameter than the required size and reamed after assembly to the full size.

Steel members adjustment shall be provided with slotted holes as shown on the drawings. Suitable templates shall be used for proper location of the holes.

Fabrication Tolerances: Unless otherwise shown on the drawings, the fabricating tolerances shall generally be as follows:

- a) Compression members shall not deviate from straightness by more than $1/1000$ of the axial length between points which are to be laterally supported.
- b) A variation of 1 mm is permissible in the overall length of members with both ends finished for contact bearing, Members without ends finished for contact bearing which are to be framed together in parts of the structure, may have a variation from the detailed length not greater than 2mm for members 10 metres or less in length and not greater than 3 mm for members over 10 metres in length.

Assembly

All connections shall be either bolted or welded as shown on the drawings. Contractor shall not redesign or alter any connection without prior approval of Engineer-In-Charge.

The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be prepared so that the specified camber if any is provided. Drafting done during assembly shall not distort the metal or enlarge the holes. Poor matching of holes shall be cause of rejection. However if permitted by the Engineer-In-Charge, holes that must be enlarged due to mismatching shall be reamed.

Bolting

High strength bolts shall be used in bearing or friction as shown on the drawings.

Anchor bolts shall be set by use of templates secured firmly in place to permit true positioning of the bearing plates and assemblies. When in drawings anchor bolts are shown to be installed in sleeves, the sleeves shall be completely filled with grout.

Welding

Welding shall be done in accordance with IS:816.

Welding procedures shall be based on the specific analysis of any given heat of steel (based on the certified mill test reports) and shall be subject to the review of the Engineer-In-Charge.

These procedures shall call for one or all of the following

- a) Proper bead shape.
- b) Minimized penetration to prevent dilution of the weld metal with the alloy elements.
- c) Preheating, controlled interpass temperature and controlled heat input.

Welding shall be performed only by qualified and tested welders specifically trained and experienced for the type of job required to execute the welding work to the

complete satisfaction of the Engineer-In-Charge. However periodical testing of welders shall be done as per IS 817, IS 7310 (Part I) and IS 738 (Part I).

Use of standard weld symbols as adopted by IS : 813 is mandatory. Pre-qualified joints which are detailed, prepared and welded in accordance with the requirement of IS : 816 shall be invariably used.

Structural welding shall not commence until joint elements are bolted or tacked in intimate contact and adjusted to dimensions shown with allowance for any weld shrinkage that is expected. Welding sequence shall be planned and controlled to minimise undue stress Increase or undue distortions in restrained members. Heavy sections and those having a high degree of restrain shall be welded with low hydrogen type electrodes.

If copper wire spacers are used between two surfaces to be welded to reduce transverse stresses in the weld, care shall be taken that it does not mix with the weld metal.

Concave bead shape shall be avoided. Ratio of weld width to weld depth shall preferably vary from a minimum of 1 to 1, to a maximum of 1.4 to 1.

width-of-weld

————— = 1 to 1.4

depth of fusion

Subsequent to fabrication, the overlapping or contacting surfaces, or other closed sections (such as tubular, box section) which are inaccessible to painting shall be seal welded. When the end of the tube is not automatically sealed by virtue of its connection by welding to another member the end shall be properly and completely sealed. Before sealing, the inside of the tube shall be made dry and free from loose scale.

Order of assembly of the tubular sections shall consist of welding the tensile member to the main member first. Compression members shall be cut back to overlap the tensile member and then welded to both of these members.

No welding shall be done when the surface of the member is wet nor during periods of high wind. No welding shall be done on base metal at a temperature below -50°C . Base metal shall be preheated to the temperature as per relevant IS codes.

Each layer of multiple layer weld except root and surfaces runs may be moderately peened with light blows from blunt tool. Due care should be taken to prevent scaling or flaking of weld and base metal from over peening.

Electrodes other than low-hydrogen electrodes shall not be permitted for thicknesses of 32 mm and above.

Tolerances: The dimensional and weight tolerances for rolled shapes shall be in accordance with IS 1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerance for fabrication of structural steel shall be as per IS 7215.

End milling: Where compression joints are specified to be designed for bearing, the bearing surfaces shall be milled true and square to ensure proper bearing and alignment

Inspection

The contractor shall give due notice to the Engineer-In-Charge in advance of the work getting ready for inspection. All rejected material shall be promptly removed from the site.

No materials shall be painted or erected or despatched to site without inspection and approval by the Engineer-In-Charge.

The Contractor shall provide all the testing and inspection services and facilities for shop works except where otherwise specified.

For fabrication work carried out at site, the same standard of supervision and quality control shall be maintained and inspection and testing shall be conducted in a manner satisfactory to Engineer-In-Charge.

Testing of welds

Welds shall be inspected as per CPWD Specification for flows by any of the methods given below. The choice of method shall be determined by Engineer-In-Charge.

Liquid penetrate inspection: These tests shall be carried out as per IS codes. All defects shown shall be repaired and rechecked.

Radiographic Inspection: These tests shall be carried out as per IS/relevant codes. All defects shown shall be repaired and rechecked.

Test failure: In event of failure of any member to satisfy inspection or test requirement, the contractor shall notify the same to Engineer-In-Charge. Before repairing contractor shall obtain permission from Engineer-In-Charge. The quality control procedures to be followed to ensure satisfactory repairs subject to approval of Engineer-In-Charge.

The contractor shall maintain records in all inspection and testing which shall be made available to the Engineer-In-Charge as and when required.

Erection

As far as possible, the Contractor shall deliver the fabricated steel work to the site in the same sequence as that which he wishes to follow for the erection. Dispatch should be scheduled to avoid cluttering up of the site. The bolts required for erection shall be bagged according to size prior to dispatch.

All structural work shall be erected in accordance with IS : 800/IS : 806 and IS : 1915 and as per the approved erection drawings. The Contractor shall be responsible for setting out the works. The suitability any capacity of all plant and equipment used for erection shall be to the Satisfaction of Engineer-In-Charge. These shall be regularly serviced and maintained. Occupational safety practices shall be strictly adhered to and shall be to the satisfaction of the Engineer-In-Charge.

No permanent bolting or welding shall be done until proper alignment has been obtained. Erection of the parts with any moderate amount of reaming, chipping or cutting shall be immediately reported to the Engineer-In-Charge. The steel work shall be rejected unless corrective action is approved by the Engineer-In-Charge.

No erection shall be permitted more than 2 story above a complete bolted and/or welded floor or above a decked surface.

Placement of joists shall not start until the supporting work is secured. Temporary bridging, connections and anchors shall be provided to assure lateral stability during erection. Bridging to steel joists shall be installed immediately after joist erection, before any construction loads are applied. Horizontal or vertical bridging shall be provided in accordance with the type of span of the joists. Ends of the bridging lines shall be anchored at top mid bottom chords when terminating to walls or beams.

Erection Tolerances: The Contractor shall control the erection of steel structures in such a way that in level no components are more than 10mm out of their correct position nor shall the lines of the structure depart from straightness and plumb by more than 3mm in metres. The error shall be measured from the designed position of level given by the dimensions and co-ordinates on the drawings.

In structures where movements due to temperature change considerable the deviations listed above will apply at the morning position of the member being checked.

Field Modification

Correction to accommodate minor misfits in steel structure by moderate use of drift pins and reaming will be permitted. Errors that cannot be corrected by these measures, but require modifications must be reported immediately to the Engineer-In-Charge along with Contractor's proposed solution.

Grouting under base plates

Grouting under base plates shall be done after erection of the structural steel unless otherwise approved by the Engineer-In-Charge. All bearing plates, bearing assemblies and masonry plates shall be steel level and to the elevations shown on plans. These shall be shimmed with approved means and grouted to assure full bearings on the supporting substrata regardless of the tolerances otherwise permitted.

The grout to be used in superstructure stanchion bases shall be cement mortar 1: 2 (1 cement: 2 coarse sand) and shall have a 28 days compressive strength of at least 300 kg/sqm. The surface which are to receive the grout shall be thoroughly cleaned immediately prior to the grouting operation. The grout shall be carefully worked under the base plates and shall completely fill the space under the base plates. Air pockets in the grout packing shall be avoided.

After the grout has had its initial set, the grout shall be cut back flush with the base plate and the surplus grout shall be removed. Before leaving the site the Contractor shall retighten the nuts of all anchor bolts.

Cleaning & Paint touching

After erection, exposed surfaces of filed connections, unpainted areas adjacent to tie connections and damaged area in the shop coat shall be cleaned to the same standards required or the shop cost. These shall then be painted with the same used in the shop coat.

Inserts & Embedments: Various steel inserts and embedment are required under the Contract to be fabricated, positioned and secured firmly into place inside the formwork prior to concrete being poured. There are also requirements of jointing, threading, bolting and inserts and embedment of different concrete and structural steel elements in order to establish structural continuity and connection. Great care shall be exercised by the Contractor in executing all aspects of the work related to inserts and embedment - including tolerances so that the final assembly of the concrete elements can meet satisfactorily the continuity and contiguity requirements intended in the structure.

MS perforated Sheet for Access corridor:

2mm thick MS perforated Sheet on MS Tubular framework with 6mm dia holes at 10mm c/c pitch @ 45 degrees etc. complete shall be provided as per architectural drawing or as directed by Architect / Engineer- in-Charge. Acrylic Aliphatic Polyurethane Paint to be done as per specifications.

Rolling shutters : Rolling shutters shall be of approved make, made of 80x1.25 mm size M.S. laths, interlocked together through their 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 mechanical device chain and crank operation for operating rolling shutters complete, including providing and fixing necessary 27.5 cm long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 - part 1 , ball bearing & M.S. top cover 1.25 mm thick for rolling shutters . Rolling shutters shall be partly grilled or partly fixed as per architectural GFC drawing. Grilled rolling shutters manufactured out of 8 mm dia M.S. bar instead of laths as per design approved by Engineer-in- charge.

Acrylic Aliphatic Polyurethane Paint on M.S Structural Steel

On MS Structural Steel Coming in Access Corridor

Surface Preparation: Preparing the structural steel surfaces to ensure complete removal of mill scale by grit / sand blasting confirming to SA 2.5 Swedish Standard. to achieve rust free surface. The surface should be free of all visible oil, grease, dust, dirt, mill scale, rust, oxides, corrosion products and other foreign matter. The entire work shall be carried out as per manufacturers specification or as per directions and to the satisfaction of the Engineer-in-charge.

Anti-corrosive protective paint & primer:

- (a) First coat of two component Zinc Silicate Primer, with minimum dry film thickness (DFT) of 65 microns and a Zinc content of 80% on dry film, the primer shall be applied by spray only. Brushes shall be used only for touch-up work.
- (b) Second Coat of High solid, micaceous iron oxide pigmented epoxy coating for structural steel surfaces with minimum dry film thickness of 100 microns per coat and Volume solid 80%
- (c) Finish coat shall be one coat of two components, high solid acrylic aliphatic polyurethane Satin finish with minimum dry film thickness (DFT) of 60 microns with Volume Solid approx 64% complete as per manufacturers specification, the entire work shall be carried out as per directions and to the satisfaction of the Engineer-in-charge.

Total minimum DFT of the system shall be 225 Microns

On MS Structural Steel coming in any other building other than Access Corridor

Surface preparation: Preparing the Structural steel surfaces to ensure complete removal of mill scale by ST2/ST3 using power / manual tool (Hand tool cleaning is a method of preparing steel surfaces by the use of power hand tools or non-power hand tools. Hand tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. The entire work shall be carried out as per manufacturers specification or as per directions and to the satisfaction of the Engineer-in-charge.

Anti-corrosive protective paint & primer:

- (a) Two coats of two component Surface Tolerant Epoxy Primer with minimum dry film thickness (DFT) of 150 microns (75 microns each coat) and Volume Solid of 80%, The primer shall be applied by spray only. Brushes shall be used only for touch-up work.
- (b) Final coat shall be followed by applying one coat of two component, high solid acrylic aliphatic polyurethane Satin finish coat of approved list brand, shade and quality with minimum dry film thickness (DFT) of 60 microns with Volume Solid

approx 64%, The entire work shall be carried out as per directions and to the satisfaction of the Engineer-in-charge.

Total minimum DFT of the system shall be 210 Microns

STAINLESS STEEL WORK

STAINLESS STEEL GRADE AISI 304 “WELD FREE” RAILING

Stainless steel grade AISI 304 “weld free” railing are coming at different location as mentioned in GFC drawing are following

- a) S.S Railing comprises of 50 mm dia tube top handrail, 38 mm dia pipe single vertical balusters, 4 Nos. mid rail of S.S. tube dia 19mm.
- b) S.S Railing comprises of 50mm dia Handrail fixed on 10x50x210mm (or approved equivalent size) S.S. Solid baluster with glass holding accessories (including top bracket to hold hand railing), placed at maximum 1200mm c/c along with 12mm thick toughened glass connected with baluster with special glass holding fixtures.
- c) S.S Railing comprises of 50 mm dia tube top handrail, Single vertical balustrade SS Flat 50 X 10 mm minimum thickness, 3 nos. mid rail of SS tube 19mm.

Or as per the approved GFC Drawing & instructions of E-I-C.

Detail description

- A. Providing modular passivated satin stainless steel “weld free” railing system at all locations & levels (as per architectural drawings) of approved size and shape conforming to grade AISI 304 with all modular accessories using flexible bends & modular system or expansion & ball socket system as per manufacturer’s specifications or as per detailed Architectural Drawings, Manufacturer Technical Specification and as directed by Engineer-in-charge. Load calculations & Material test reports for SS 304 grade to be submitted by vendor. The material comprises of top handrail shall be S.S. tube dia 50 mm x 1.5 mm (+/-0.1mm) minimum thickness, single vertical balusters shall be of 38 mm dia pipe of 1.5 mm (+/-0.1mm) minimum thickness at 1m to 1.2 m c / c & at turning with 4 Nos. mid rail of S.S. tube dia 19mm x 1.5 mm (+/-0.1mm) minimum thickness and mounted all balusters with blind rivet. The balusters may be fixed on the horizontal or vertical surface as desired with minimum 6 mm thick SS base plate & base plate shall be concealed with suitable SS 304 grade cover cap as per manufacturers specification. Baluster to hold handrail using flexible bends & modular system or expansion & ball socket system for all joints, turns etc. The entire fixing shall be completed as per manufacturer's specification & as per architectural drawing and approval of Engineer-in-charge.
- B. Supply and installation of AISI 304 Grade Stainless Steel satin finish Knock Down railing system comprising Ø 50mm Handrail fixed on 10x50x210mm S.S. Solid baluster with glass holding accessories (including top bracket to hold hand railing), placed at maximum 1200mm c/c along with 12mm thick toughened glass connected with baluster with special glass holding fixtures. The Glass height should be taken as minimum 845mm. The balustrade would be fixed onto floor with SS 304 Grade base plate of 100x60x8mm thickness. Base plate shall be concealed with

suitable S.S. 304 grade cover Cap so that the mounting anchor fasteners are not visible after installation. Wall thickness of all Pipes shall be taken as 1.5mm along with all visible components developed in High Grade S.S. and whenever required, joints to be filled with bushings for extra strength. Railing height to be taken 1000 mm from floor level. The entire fixing shall be completed as per manufacturer's specification & as per architectural drawing and approval of Engineer-in-charge.

- C.** Providing & fixing modular passivated Satin stainless steel finish “weld free” railing system at suitable locations at all levels of approved size and shape conforming to grade AISI 304. Top Handrail Shall be SS Tube of minimum dia 50 mm X 1.5 mm minimum thickness , Single vertical balustrade shall be of SS Flat 50 X 10 mm minimum thickness at 1m to 1.2m C/C & at turning with 3 nos. mid rail of SS tube 19mm X 1.5mm minimum thickness fix with connectors to all balusters to support infill as per manufacturers specification, The balustrade will be fixed on the vertical surface (side mount) with SS 304 grade wall bracket by SS 304 M10x100 Hilti fasteners & Anchor (M10X70 mm) or as per manufacturers specification. Entire fixing shall be completed as per manufacturer's specification & as per architectural drawing and approval of engineer -in-charge. Load calculations & Material test reports for SS 304 grade to be submitted by vendor. Railing height will be 1000 mm from FFL.

Samples & Shop drawings: All work to be done as per GFC Drawing. Sample including complete modular system & shop drawings shall be submitted by the contractor for approval prior to the execution of work.

The works also protected by wrapping bubble sheet till completion / handing over of the building whichever is later. If any scratches and damages occur shall be replaced or rectified at their own cost and nothing extra shall be paid against the same.

STAINLESS STEEL GRADE 304 WALL LINING

Providing, fabricating & fixing in position as per detail given in GFC drawing, gutter & drain wall lining (minimum 2 mm thick SS sheet) & other similar work as called for with Stainless Steel of SS Grade-304 consisting of S.S. sheet, S.S. flats, S.S. plate, angles, S.S. hinges etc. including all fixing accessories such as S.S. inserts etc., all cutting, bending, welding, grinding, drilling, tapping and all other incidentals, and approved buffing to stainless steel members as directed by the Engineer-in-charge. complete.

Freight Lift: Stainless steel grade 304 jambs over M.S. framework shall be provided at all levels of freight lift as per GFC drawing.

Note: All stainless-steel works shall be executed through authorized/trained/recommended installer of manufacturer or as decided by Engineer in charge.

FLOORING

Floor finishing margin shall be 100 mm out of which lower part 50 mm is left for services (Raceways, conduits etc) filled with cement concrete 1:3:6/1:2:4 as shown in GFC drawing & balance 50mm thick is for floor finishing / leveling requirement shall be catered with 1:4 cement mortar up to desired level for which nothing extra shall be paid.

The works should be protected by laying 2mm thick POP over paper till completion / handing over of the building whichever is later. If any scratches and damages occur they shall be replaced or rectified at their own cost and nothing shall be paid against the same.

All flooring works with or without pattern shall be executed as per design/ mockup approved by Architect and E-I-C.

IPS Flooring (Cement Concrete Flooring): 52 mm thick cement concrete flooring with concrete hardener topping, under layer 40 mm thick cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) and top layer 12 mm thick cement hardener consisting of mix 1:2 (1 cement hardener mix : 2 graded stone aggregate 6 mm nominal size) by volume, hardening compound mixed @ 2 litre per 50 kg of cement or as per manufacturer's specifications. **This includes cost of cement slurry and nosing of steps etc. complete if required.**

Cement Plaster Skirting: 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.

Floor strips: Aluminium strip 35 mm wide and 3 mm thick to be fixed in a pattern as shown in drawings or as directed by E-I-C in joints of cement concrete floors.

Vacuum dewatered flooring: C.C. flooring of mix M-35 or as mentioned in drawing. 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. The slump of concrete shall be maintained in range 30-50

Polished Kota / Polished Tandur stone/ Sand blasted leather finish kota / Sand blasted leather finish Tandur stone / Polished Rajim / Sand blasted leather finish Rajim stone / polished Mandana / Sand blasted leather finish Mandana stone with cement mortar shall be provided in a pattern / combination at locations as shown in GFC drawings and as per CPWD Specification.

Stone flooring with Epoxy joints; Stone flooring with Epoxy joints shall be provided at location & pattern as shown in GFC drawings including keeping the joints 4 mm wide & 6 mm deep all around & filled with approved quality epoxy grout as per manufacturers specification in flooring. For detail refer GFC drawings.

The treads & risers of steps should be in one single long piece up to 2000mm length as per the drawing. Nosing / moulding in treads shall be as per GFC drawings.

Polished Mandana stone 30 mm thick: Polished mandana stone 30 mm thick shall be provided over all external window cills, Parapet tops / low height walls, planters tops, coping etc including nosing / moulding as per GFC drawing and design.

Polished kota / Tandur stone 25 mm thick: Polished kota / Tandur stone 25 mm thick shall be provided over all internal window sills, planters tops, coping, cills etc including nosing / moulding as per GFC drawing and design.

Bilha stone (Polished / Unpolished) shall be provided at plinth protection or similar locations as mentioned in GFC drawings and as per CPWD Specification.

Gang-saw-cut 18mm thick Mirror Polished Granite & Sand blasted leather finish Granite (of approved shade) for flooring, Skirting, Treads, riser and wall cladding:

Gang-saw-cut 18mm thick Mirror polished granite & Sand blasted leather finish Granite 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.

The treads & risers of steps should be in one single long piece up to 2000mm length as per the drawing. Nosing / moulding in treads shall be as per GFC drawings. Granite Wall Cladding of height as shown in GFC drawing shall be provided at all lifts Fascias in all floors.

All skirting shall be 100 mm/150 mm (as per GFC) of same material unless specified. It should be flush with wall with groove 10x6 mm.

Mirror Polish : Mirror polishing on Granite work / stone work shall be done where ever required as shown in Architectural Drawings to give high gloss finish complete as per manufacturers specification.

Sand blasted Leather finish: Sand blasted Leather finish on Granite work / stone work shall be done where ever required as shown in Architectural Drawings to give high gloss finish complete as per manufacturers specification.

Vitrified tiles flooring

20 mm thick Antiskid/full body Industrial Vitrified tiles flooring & skirting : Flooring shall be approved uniform colour and size (60cm x 60cm) 20 mm thick fullbody Antiskid Industrial Vitrified tiles of approved make including cleaning the surface thoroughly with wire brush, applying bonding coat with neat cement slurry on concrete surface and fixing tiles over 20 mm thick cement mortar bedding 1:4 (1 cement:4coarse sand) admixed with approved admixture in proportion (50 kg cement+200 kg sand+3 litre admixture + requisite water) with neat cement slurry admixed with approved admixture in proportion (50 kg cement+5 litre admixture + water) @ 3.3kg per sqm, keeping the joints 3 mm wide& minimum 6 mm deep around & filled with approved quality epoxy grout. Skirting shall be with same tiles laid over 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand).

15 to 16 mm thick Antiskid/full body Industrial Vitrified tiles flooring & skirting

: Flooring shall be approved uniform colour and size (60cm x 60cm) 15 to 16 mm thick fullbody Antiskid Industrial Vitrified tiles of approved make including Cleaning the surface thoroughly with wire brush, Applying bonding coat with neat cement slurry on concrete surface and fixing tiles over 20 mm thick cement mortar bedding 1:4 (1 cement:4coarse sand) admixed with approved admixture in proportion (50 kg cement+200 kg sand+3 litre admixture + requisite water) with neat cement slurry admixed with approved admixture in proportion (50 kg cement+5 litre admixture + water) @ 3.3kg per sqm, keeping the joints 3 mm wide & minimum 6 mm deep around & filled with approved quality epoxy grout. Skirting shall be with same tiles laid over 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand).

Matt / polished /Antiskid/full body/Double Charged Glazed Vitrified floor tiles

9 to 10 mm thick : Flooring shall be approved uniform colour and size 60 X 30 cm / 60 X 60 cm / 80 X 80 cm/ 60 X 120 cm/100 X 100 cm/80 X 120 cm/120 X 120 cm 9 to 10 mm thick Antiskid/full body/Double Charged Glazed Vitrified floor tiles of approved make including Cleaning the surface thoroughly with wire brush, Applying bonding coat with neat cement slurry on concrete surface and fixing tiles over 20 mm thick cement mortar bedding 1:4 (1 cement:4coarse sand) admixed with approved admixture in proportion (50 kg cement+200 kg sand+3 litre admixture + requisite water) with neat cement slurry admixed with approved admixture in proportion (50 kg cement+5 litre admixture + water) @ 3.3kg per sqm. Keeping the joints 3 mm wide & minimum 6 mm deep around & filled with approved quality epoxy grout. Skirting shall be with same tiles laid over 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand).

Matt / polished Vitrified wall tiles 9 mm (+/- 1 mm) thick : Wall cladding / dado

shall be of approved uniform colour and size 60 X 30 cm / 60 X 60 cm 9 mm thick Matt / polished Vitrified wall tiles of approved make including fixing tiles over 12 mm thick bed of cement mortar 1:3 (1 Cement : 3 Coarse sand) and jointed with grey cement slurry @ 3.3 Kg per sqm including pointing in white cement mixed with pigment of matching shade including keeping the joints 3 mm wide & minimum 6 mm deep around & filled with approved quality epoxy grout. The heights of dado shall be as per GFC architectural drawing.

All tiles shall be of 1st quality as per approved sample, brand, manufacture, colour and shade.

Ceramic Glazed Floor tiles 8 mm thick: Rectified Glazed Ceramic floor tiles shall be of size 300x300 mm or more 8mm thick, of 1st quality conforming to IS : 15622, of approved make, in colours White, Ivory, Grey, Fume Red Brown, 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., complete.

Ceramic Glazed Wall tiles 8 mm thick: Ceramic glazed wall tiles (1st quality) conforming to IS: 15622 8mm thickness, 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.

Antistatic Flooring - ESD vinyl

It should meet the most relevant needs of the customer interests - including cost, durability, ergonomics, compliance with safety standards, appearance, total cost of ownership and of course ESD properties. The flooring should conform to standards EN 1081/IEC 613404, EN 1815 & EN 12466. Solid vinyl tile (SVT) (2mm). It should be simple to repair and easy to clean. The joints between individual tiles should be welded by heat fusion process to get a seamless floor the joints in the flooring should be sealed by using a PVC welding bar of matching colour to supply by the manufacturer using a hot air gun for fusion of welding bar with flooring. SVT should be conductive flooring within the OT area to prevent damage to sensitive medical electronic equipment, inadvertent movement of surgeons / technicians, accumulation of static dirt. Providing & fixing 2mm thick Conductive flooring with carbon backing total thickness 2.00mm, total weight 3.000 g/m² polyurethane reinforced, scratch resistant, fire resistant, chemical resistant, slip resistant, anti-fungi & bacterial growth, dimensional stability ≤0.40%, static electrical charger < 2Kv, impact sound reduction approx. +4bd, electrical resistant. Installation: The flooring would be installed on a smooth, clean sub floor which should be free from any undulation Copper grounding strips. (0.05mm thick, 50mm wide) will be laid flat on the floor in the conductive adhesive and connect to copper wire of grounding.

Epoxy Grout-Grouting the joints of flooring tiles / stones having joints of 3 & 4 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.

Lecture Halls Tier: All lecture hall tiers, shall be made based on levels mentioned in drawings with 230 mm thick cement-based fly ash brick wall as toe walls (with 1st class) in cement mortar 1:6 (1 cement: 6 coarse sand) as per drawings. The tier thus formed shall be filled with light weight machine mixed Autoclaved aerated cement (AAC) blocks concrete in volumetric proportion 1:4:8 (1 cement: 4 coarse sands: 8 AAC block aggregate 40 mm nominal size) & 75 mm thick PCC 1:4:8 (1 cement: 4 coarse sands: 8 graded stone aggregate 20 mm nominal size) below the final floor finish as per GFC drawing.

Raised / false access flooring as per item code 11.54 DSR 2018 : Providing and fixing removable raised / false access flooring with system and its components of approved make for different plenum height with possible height adjustment up to 50 mm, comprising of modular load bearing floor panels supported on G.I. rectangular stringer frame work and G.I. Pedestal etc. all complete, as per the architectural drawings, as specified, as per manufacturer specification and as directed by Engineer-in-charge for 600 mm finished floor height (FFH) or height as mentioned in GFC drawing.

Providing at required spacing to form modular framework, pedestals made out of GI tube of thickness minimum 2 mm and 25 mm outer diameter, fully welded on to the G.I. Base plate of size 100mm x 100mm x 3mm at the bottom of the pedestal tube, G.I.

pedestal head of size 75mmx75mmx3.5 mm welded with GI fully threaded stud 16mm outer diameter with two GI Check nuts screwed on the stud for level adjustment upto 50mm, locking and stabilizing the pedestal head in position at the required level. The pedestals shall be fixed to the subfloor (base) through base plate using epoxy based adhesive of approved make or the machine screw with rawl plug.

Stringers system in all steel construction hot dipped galvanized of rectangular size 570x20x30x0.80mm thick having holes at both ends for securing the stringers on to the pedestal head using fully threaded screws ensuring maximum lateral stability in all directions, the grid formed by the pedestal and stringer assembly shall receive the floor panel, this system shall provide adequate solid, rigid support for access floor panel, the system shall provide a minimum clear uninterrupted clearance between the bottom of the floor for electrical conduits and wiring etc. all complete as per the architectural drawings, as specified and as directed by the Engineer-in-charge.

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 0.7 mm 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 noncombustible Portland cementitious core 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.

Heat Resistant Tile :- Providing and fixing Heat Resistant Terrace Tiles (300 mm x 300 mm x 20 mm) with SRI (solar refractive index) > 78, solar reflection > 0.70 and initial emittance > 0.75 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 & marble powder in ratio of 1:1, including rubbing and polishing of the surface upto 3 cuts complete, including providing skirting upto 150/300 mm height along the parapet walls in the same manner.

Stone With Epoxit Grout :- Providing & laying 25 mm thick sand blasted leather finish/polished Rajim/Kota/ Kadappa stone in areas as mentioned in drawing to the approved pattern as directed using 25 mm (nominal) thick stone slabs with machine cut edges (straight or raked as called for) of sizes 600x600mm. The stone shall be fixed as per detail specification below

(1) Cleaning the surface thoroughly with wire brush. (2) Applying bonding coat with neat cement slurry @ 2.75 kg/sqm on concrete/brick bat coba surface. (3) Fixing

stones with cement paste @ 4.4 Kg/SqM over green finishing top coat 20 mm thick cement mortar 1:4 (1 cement : 4 coarse sand) of brick bat coba, keeping the joints 4 mm wide & 6 mm deep all-round for epoxy grouting complete including rubbing and polishing as directed by Engineer-in-Charge. The joint should be filled with approved quality anti-fungal epoxy grout Latapoxy 2000 of M/s Laticrete or approved equivalent, as per manufacturer specifications or as directed. Skirting shall be with 20 mm thick stones over 12mm (average) thick CM 1:3 (1 cement: 3 coarse sand).

Tactile tile : 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

Phenol bonded Bamboowood flooring: Providing & fixing in position Phenol bonded Bamboowood flooring with planks of sizes 14mm thick, minimum 1800mm length and minimum 100 mm wide, in approved colour, texture and finish, having Performance Appraisal Certificate (PAC) issued by Building Materials & Technology Promotion Council (BMTPC). The flooring shall be fixed with tongue and groove interlocking system, with underlayment of 4mm thick expanded polyethylene foam sheets having density 40kg/cum, over prepared surface with necessary quarter round planks of size 1900mm x 18mm and door reducer of size 1900mm x 44mm, wherever required. The bamboowood planks shall have minimum density of 1000 Kg/cum & minimum Hardness 1000 Kgf. with Eco friendly UV coating, all complete as per direction of the Engineer in-charge.

Wash basin Counter: 18 mm thick gang saw cut mirror polished Granite stone (premoulded and prepolished) machine cut of required size of approved shade, colour and texture laid over 20mm thick base cement mortar 1:4 (1 cement: 4 coarse sand) with joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing moulding as per drawing and polishing to edge to give high gloss finish.

Wash basin fascia & drops: 18 mm thick gang saw cut mirror polished Granite stone (premoulded and prepolished) machine cut of required size of approved shade, colour and texture of width upto 150 mm fixed with epoxy resin-based adhesive of approved make including cleaning.

Wash basin openings: Opening of required size & shape for wash basins platform, and similar location in marble/stone work including necessary holes for pillar taps etc. including rubbing and polishing of cut edges shall be provided & nothing extra to be paid for this account.

Mirrors: Mirror shall be 6 mm thick bevelled edge mirror of superior float glass (of approved quality) complete over 6 mm thick marine ply fixed to wooden cleats with

stainless steel screws, washers and caps complete as per drawing or as directed by E-I-C.

Over Head Tanks: Internal floor & wall finish of Overhead Water Tanks / domestic / Fire / Flushing tanks shall be Acrylic Cementitious Modified two component waterproofing as per manufacturers specification finished with 300x300mm glazed Ceramic tiles over 12 mm thick bed of cement mortar 1:3 (1 Cement: 3 Coarse sand) and jointed with grey cement slurry @ 3.3 Kg per sqm including pointing in white cement mixed with pigment of matching shade. For detail refer GFC drawings.

Over Head tank top cover shall be 455 X 610 mm rectangular C.I. Cover with frame (light duty) including lockable arrangement, the total weight of cover and frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg.) & rungs shall be 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 mm x 25 mm and over all minimum length 263mm and width as 165mm with minimum 112mm space between protruded legs having 2mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138mm as per standard drawing or as per CPWD specification.

All work in general shall be carried out as per CPWD Specifications- 2019 - Vol.I& Vol. II with upto date correction slips.

Whenever flooring is to be done in patterns tiles/ stone, the contractor shall get samples of each pattern laid and approved by the Engineer-in-Charge before final laying of such flooring for which nothing extra shall be paid.

Different stones/ tiles used in pattern flooring as per the approved architectural drawings and nothing extra for laying pattern flooring shall be paid. No additional wastage if any shall be accounted for any extra payment.

The proper gradient shall be given to flooring for toilets, verandah, kitchen, court yard, etc. as per the directions of Engineer-in-Charge. For this there may be extra thickness of dry mortar below the tiles/stone slabs. These gradients should be insured in the shuttering itself for which nothing extra shall be paid.

One-piece stone for treads / risers in staircase shall be used and nothing extra shall be paid on this account.

FALSE CEILING

Materials shall be of the best-approved quality obtainable and they shall comply with the respective latest Standard Specifications. Samples of all materials shall be got approved before placing order and the approved sample shall be deposited with the Engineer in Charge, which will be displayed at site as a control sample.

In case of non-availability of materials in metric sizes, the nearest size in FPS units shall be provided with the prior approval of the E.I.C.

Materials shall be tested in any approved testing Laboratory and the test certificate in original shall be submitted to the Engineer-in-Charge.

All work to be done by Manufacturer's Authorized/Recommended/Trained Installer or as approved by Engineer-in-Charge.

Note: -Trap door/Inspection door of required size to be provided by contractor in false ceiling as per service requirement and approved shop drawing or as decided by EIC and door opening/closing should be smooth and robust for easy maintenance.

GYPSUM BOARD SINGLE LAYER FALSE CEILING

Providing and fixing 12.5 mm thick tapered edge gypsum plain board conforming to IS: 2095 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, cutouts made with frame of perimeter channels suitably fixed (if any additional members required at cutouts shall be provided free of cost) all complete as per drawings, specification and direction of the Engineer in Charge including final finishing and painting as per GFC drawing.

GYPSUM BOARD DOUBLE LAYER FALSE CEILING

a. Material: Gypsum board Plain 12.5 mm thick which have gray face paper and brown reverse side paper suitable for most applications where Normal fire, Structural and Acoustic levels are specified. Applicable standard of the boards should be IS 2095 (Part 1):2011 (BIS Certified) and should have thermal conductivity and thermal resistance of 0.16 and 0.078 (w/m²K). The boards should have Taper edge along length of board and square edge along width of board. Flexural breaking load of Gypsum board as per IS 2095 (Part 1):2011 is 180 N in Transverse Direction and 500 N in Longitudinal Direction. Ceiling is in 2 layers with staggered joints.

b. Frame work : - Providing and fixing of frame work made of special/seratted sections, power pressed from M.S. sheets and galvanized with zinc coating of minimum 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 900 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 900 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 double layer of 12.5mm tapered edge Gypsum board Plain (conforming to IS 2095-Part 1:2011, BIS Certified board) is then screw fixed to ceiling section with 25mm drywall screws for first layer and 35 mm drywall screws for second layer at 230mm centres on ceiling section & 150mm at periphery of ceiling including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound, jointing tapes, 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, cutouts made with frame of perimeter channels suitably fixed (if any additional members required at cutouts shall be provided free of cost) all complete as per drawings, specification and direction of the Engineer in Charge including painting as per GFC drawing.

ALUMINIUM TILE FALSE CEILING

1. LAY-IN PLAIN TILE ALUMINIUM FALSE CEILING

a. Material: Aluminium metal ceiling consisting of 600 mm X 600 mm / 600 mm x 1200 mm Aluminium Lay-in plain tiles in 0.7 mm thickness. The tile shall be Powder coated minimum 60microns in the manufacture's standard colour shades, with Microlook edges and flanges, produced on advanced equipment, which includes several levelling stages in the manufacturing process. The tiles should have Fire Performance of Class 0/Class 1 as per BS476 Part 6 & 7 standard in module size of 600 mm X 600 mm / 600 mm x 1200 mm

2. LAY-IN PERFORATED TILE ALUMINIUM FALSE CEILING

a. Material: Aluminium Metal Ceilings system Microlook, Micro Perforated (having 1.8 mm diameter holes & 20 % open area) consisting of 600 mm X 600 mm / 600 mm x 1200 mm Lay in tiles in 0.7 mm thick Aluminum pre coated to Global white color with Acoustical fleece of soundtex or equivalent make hot pressed on the back of the perforated tile. The tile shall be Powder coated minimum 60 to 80microns in the manufacture's standard colour shades.

The tiles would have NRC of 0.70. The tiles would have Fire Performance of Class 0/Class 1 as per BS476 Part 6 & 7 standard in module size of 600 mm X 600 mm / 600 mm x 1200 mm.

3. LAY-IN PERFORATED TILE ALUMINIUM FALSE CEILING WITH 50 MM THICK FIBRE GLASS WOOL

a. Material : Aluminium Metal Ceilings system Microlook, Micro Perforated (having 1.8 mm diameter holes & 20 % open area) consisting of 600 mm X 600 mm / 600 mm x 1200 mm Lay in tiles in 0.7 mm thick Aluminum pre coated to Global white color with Acoustical fleece or equivalent make hot pressed on the back of the perforated tile to achieve NRC upto 0.7 & 50 mm thick Resin Bonded Fibre glass wool conforming to IS : 8183, density 24kg / m³ & NRC upto 1.0, wrapped in 40 to 45 GSM Fibre glass tissue laid over perforated tile. The tile shall be Powder coated minimum 60 to 80microns in the manufacture's standard colour shades. The tiles would have Fire Performance of Class 0 / Class 1 as per BS476 Part 6 & 7 standard in module size of 600 mm X 600 mm / 600 mm x 1200 mm

Frame work & Installation : - All tiles to be installed on a standard 600 mm X 600 mm / 600 mm x 1200 mm module 15mm table exposed metal grid. Grid system to be designed to satisfy ASTM C635 loading and deflection criteria. The main and cross runners to be provided with beyonet coupling for quick installation and shall have a height of 38mm.

The tile false ceiling 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 15 x 38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross "T" of size 15 x 38 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 15 x 38 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 19x19x0.3 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 M6 Anchor Fasteners with hanger hole, pre Straightened Hanger wire of dia. 2.5 mm of 1.80 m length having a tensile strength of 344-413 MPa and a minimum pull strength of 110 kgs. Adjustable hook clips of 0.7mm thick, galvanized spring steel can also be used for installation purpose as an additional accessory. The adjustable clip also consists of a 4 mm aquiline wire to be used with the main runner.

The first/last suspension system at the end of each main runner should not be greater than 450mm from the adjacent wall. Bottom exposed width of 15 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

Finally the tiles shall be laid in place from below into the standard grid. In case of end tiles lesser than 600mm, use lay-in end cap / edge profile for installation to have a

Microlook effect on perimeters. This system also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channel suitably fixed all complete as per drawing and specification and direction of the Engineer-in-charge.

CLIP-IN PLAIN TILE ALUMINIUM FALSE CEILING

Material : Providing & Fixing true horizontal level suspended ceiling comprising of Aluminum Clip-in plain tiles with double clip self-leveling feature and special tabs to allow removal of tile to enable plenum access with plain visual consisting of 600 mm X 600 mm / 600 mm x 1200 mm clip in tiles of 0.7mm thick Aluminum with bevel edge in Global white color. The tile shall be Powder coated 60-80 microns in the manufacture's standard colour shades. The tiles would have Fire Performance of Class 0/Class 1 as per BS476 Part 6 & 7 standard in module size of 600 mm X 600 mm / 600 mm x 1200 mm

b. Frame work & Installation: Frame work 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). Cut tiles to be secured to the wall angles using a spring clamp procedure. Installation to be carried out by company trained Installation team & Installation should be carried out as per manufacturer specification & recommendation.

8 MM THICK CALCIUM SILICATE BOARD FALSE CEILING

Providing & fixing 8 mm thick Calcium Silicate Board made with Calcareous & Siliceous materials reinforced with cellulose fiber manufactured through autoclaving process false ceiling 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, (if any additional members required at cutouts shall be provided free of cost) all complete as per drawings, specification and direction of the Engineer in charge including final finishing and painting as per GFC drawing.

GI CLIP IN METAL CEILING

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 1.7 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 : GI Metal Ceiling Clip in plain Beveled edge global white color 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.

MINERAL FIBRE FALSE CEILING TILES

Mineral fibre false ceiling tiles at all heights of size 595X595mm of approved texture, design and pattern with 20 mm thick beveled tegular mineral fibre false ceiling tile (NRC 0.7). The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance? 85%, Thermal Conductivity $k = 0.052 - 0.057$ 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 (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 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.

WATER PROOFING

Different types of waterproofing treatment mentioned below to be executed by contractor at locations mentioned in GFC Drawing of various buildings.

VERTICAL AND HORIZONTAL SURFACES OF DEPRESSED PORTIONS OF W.C., KITCHEN AND THE LIKE

Providing and laying water proofing treatment to vertical and horizontal surfaces of depressed portions of W.C., kitchen and the like consisting of:

- (i) Ist course of applying cement slurry @ 4.4 kg/sqm mixed with water proofing compound conforming to IS : 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.
- (ii) IInd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.
- (iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sqm of area.
- (iv) IVth course of 400-micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sqm).

INTEGRAL CRYSTALLINE SLURRY OF HYDROPHILIC IN NATURE

Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tunnels / subway and bridge deck 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 0.50 mm. 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.

ACRYLIC CEMENTITIOUS MODIFIED TWO COMPONENT WATER PROOFING:

Providing and applying waterproofing treatment to the sunken slabs, Balconies or other location as per GFC drawing, including cleaning of surface to remove dust, loose particles, etc with compressed air or any other suitable technique depending on site conditions, grinding any sharp edges, etc as per the instructions of Engineer in charge and post cleaning applying a two component acrylic modified cementitious coating system at a total consumption of 1.8 to 2 Kgs/Sqm in two coats complete as per

manufacturers specification or as directed by E.I.C..

The waterproofing system should exhibit the following properties: density: 1.5 to 2 kg/ltr, Elongation at break (ASTM D412): 200 to 250%, Crack resistance at 20 degree centigrade > 2 mm

All corners in sunken must be sealed a SealTape S, an elastic waterproof sealing tape with a woven bonding mesh on each surface and an elastic expansion zone in the center. The waterproofing should be taken to a height of 300 mm in the vertical.

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 against any leakage.

BRICK BAT COBA WATERPROOFING TREATMENT

Providing and laying integral cement-based brick bat coba waterproofing treatment to required slope / gradient as per drawing with average thickness of 120mm or can be increased as per site requirement and minimum thickness at khurra as 65 mm as per CPWD specification 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 300mm height including cleaning the surface before treatment.
- b) Laying brick bats with mortar using broken bricks/brick bats 25mm 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 20mm 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 20mm thick jointless cement mortar of mix 1:4 (1cement :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 of 300 X 300 mm square 3mm deep.
- 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.

BRICK BAT COBA WATER PROOFING TREATMENT WITH ROOF INSULATION

Providing and laying Water proofing treatment & roof insulation including preparation of surface as required for treatment of roofs, balconies, terraces etc. consisting of following operations:

1. Cleaning all the surface area to remove loose particles such as mortar, dust etc., with wire brush & air blower complete in all respect as per the direction of Engineer-in-Charge.

2. Providing & laying thermal insulation with 50mm thick extruded polystyrene having closed cell structure, ideal for insulation of roofs. XPS should have density of 32-35 Kg/cum (EN 1602), compressive strength of 300 KPa (as per EN 826); Resistance to Fire of "E" Class; Water Absorption of <0.7% (as per EN 12087); Thermal resistance of 1.5 sqm.KW; Thermal Conductivity of 0.029- 0.034 W/m-k (as per EN 12667) and should be laid directly over the mother slab, spot stuck using cold bitumen as per manufacturer specification
3. Over extruded polystyrene providing and fixing of anti punching and vapor diffusion layer made of a geotextile felt NT fibers of polypropylene is 100% pure, thermotreated, needlepunched, resistant microorganisms, weight > 200 gr /sqm.
4. For Terrace: Over geotextile felt providing and fixing 1.5mm mechanically fastened polyvinyl chloride (PVC-P) roof membrane. PVC membrane shall be reinforced with glass fibre of 50g/sqm and should have minimum roll size of 1.6m x 20m rolls) to minimize joints & shall be asbestos free. It should be mechanically fixed around the perimeter with a pre-drilled bar on the horizontal or vertical surface at the base of the upstand as per manufacturer specification. Roof Membrane should be overlapped with minimum 100 mm lap and seamed using hot air heat welding equipment.

For Parapet / wall: Over geotextile felt providing and fixing 1.5mm (60 mil) mechanically fastened polyvinyl chloride (PVC-P) by using metal perimetre profile on vertical wall /parapet. The PVC membrane is welded with Leister hot air gun over the entire length of the PVC metal Sheet. The overlaps for vertical section to be minimum 100 mm, to be sealed using hot air gun.

PVC membrane shall have following minimum properties, (i) Thickness: 1.5mm as per EN 1849-2, (ii) Tensile Strength > 9 N/sqmm as per EN 12311-2, met B (iii) Elongation of > 200% as per en 12311-2, met B (iv) Tear Resistance > 135 N as per EN 12310-2, and Cold bending of minimum < -25 deg as per EN 495-5.

5. Over PVC membrane providing separation layer with laying polyester geo textile of minimum 150 gsm. Geotextile separation layer should have weight of minimum 150 gsm; static puncture resistance of > 250N; Dynamic punsture resistance of 40MM; and should be laid over the entire area before laying Brickbat coba / screed to slope as per DSR 2023 item no. 22.7.
6. The entire treatment will be taken upto 30 cm on parapet wall or upto parapet projection as per manufacturer's specification.
7. The above mentioned waterproofing treatment & insulation finally covered with brick bat coba waterproofing treatment to required slope / gradient as per drawing with average thickness of 120mm or more as per site requirement and minimum thickness at khurra as 65 mm as per CPWD specification including final finishing layer i.e layer of plaster with trowel with neat cement slurry and making of 300 X 300 mm squares 3 mm deep groove or heat resistant tiles / stone flooring, whichever is given in GFC drawing.

Note: - A layer of PCC or Cement concrete screed is not mentioned in above treatment but to be provided if mentioned in GFC drawing.

This specification covers waterproofing & insulation of concrete roof using XPS insulation & PVC waterproofing Membrane. The sheets are welded together by applying hot air or using hot wedge, with manual or automatic welder.

The work shall be executed with the best modern practices, special instruction of the material manufacturer and to the complete satisfaction of the Engineer.

Library & Data Center: for usable roofs, balconies etc as per GFC drawing

A. Water proofing treatment without insulation

1. Cleaning all the surface area to remove loose particles such as mortar, dust etc., with wire brush & air blower complete in all respect as per the direction of Engineer-in-Charge.

2. Separation Layer: Providing and laying 500 GSM Polypropylene Geotextile on the Surface with 100mm overlap. Geotextile shall be non-woven needle punctured on both sides made of 100% virgin and high tenacity polypropylene short fibres. Having high tenacity, High resistance to alkalinity and inert towards the various chemical elements present in the soil. And High puncture resistance. Geotextile shall have following properties: Static Puncture Resistance: 7900N; Tensile Strength (DM/DT): 35/46 KN/m; Elongation (DM/DT): 75/80%.

3. Waterproofing Membrane: Synthetic membrane manufactured in Thermo Plastic Olefin (TPO), double colour sand-grey (signal layer)/black, obtained by co-extrusion, reinforced by a polyester mesh. The upper sand grey layer is featured by a very high resistance to weather and UV rays, while the underlying black layer is punching resistant.

TPO membrane shall be asbestos free, and should exceed /meet specifications of EN 13956:2012. TPO Roof Membrane shall accept roof movement and thermal shock, loosely laid on the geotextile. TPO Roof Membrane should be lapped and seamed using hot air heat welding equipment with an overlap of 80mm. TPO membrane shall have following minimum properties, (i) Thickness: 1.5 mm membrane system as per EN 1849-2 with -5% & +10% tolerances as per EN 13956. (ii) Tensile strength ≥ 1100 N/5cm as per EN 12311-2; (iii) Tear Resistance ≥ 300 N as per EN 12310-2; (iv) Resistance to impact ≥ 800 mm as per EN 12691; (v) Cold bending of minimum ≤ -40 deg as per EN 495-5; (v) Fire classification – Class E as per EN 13501-1 & EN ISO 11925-2, (vi) Static Puncture Resistance ≥ 20 kg as per EN 12730.

4. Separation Layer: Over waterproofing membrane providing and laying 500 GSM Polypropylene Geotextile on the Surface with 100mm overlap. Geotextile is a high tenacity non-woven needle punctured on both sides made of 100% virgin and high tenacity polypropylene short fibres. Having high tenacity, High resistance to alkalinity and inert towards the various chemical elements present in the soil. and High puncture resistance. Geotextile shall have following properties: Static Puncture Resistance: 7900N; Tensile Strength (DM/DT): 35/46 KN/m; Elongation (DM/DT): 75/80%

The entire treatment will be taken upto 30 cm on parapet wall or upto parapet projection as per manufacturer specification.

B. Water proofing treatment with insulation

1. Cleaning all the surface area to remove loose particles such as mortar, dust etc., with wire brush & air blower complete in all respect as per the direction of Engineer-in-Charge.

2. Providing & laying thermal insulation with 50mm thick extruded polystyrene

having closed cell structure, ideal for insulation of roofs. XPS should have density of 32-35 Kg/cum (EN 1602), compressive strength of 300 KPa (as per EN 826) ; Resistance to Fire of "E" Class; Water Absorption of <0.7% (as per EN 12087) ; Thermal resistance of 1.5 sqm.KW; Thermal Conductivity of 0.029- 0.034 W/m-k (as per EN 12667) and should be laid directly over the mother slab, spot stuck using cold bitumen as per manufacturer specification

3. Separation Layer : Over extruded polystyrene providing and laying 500 GSM Polypropylene Geotextile on the Surface with 100mm overlap. Geotextile shall be non-woven needle punctured on both sides made of 100% virgin and high tenacity polypropylene short fibres. Having high tenacity, High resistance to alkalinity and inert towards the various chemical elements present in the soil. and High puncture resistance. Geotextile shall have following properties: Static Puncture Resistance : 7900N; Tensile Strength (DM/DT) : 35/46 KN/m; Elongation (DM/DT) : 75/80%.

4. Waterproofing Membrane: Over geotextile felt providing and fixing Synthetic roof membrane as per specification. Synthetic membrane manufactured in Thermo Plastic Olefin (TPO), double colour sand-grey (signal layer)/black, obtained by co-extrusion, reinforced by a polyester mesh. The upper sand grey layer is featured by a very high resistance to weather and UV rays, while the underlying black layer is punching resistant.

TPO membrane shall be asbestos free, and should exceed /meet specifications of EN 13956:2012. TPO Roof Membrane shall accept roof movement and thermal shock, loosely laid on the geotextile. TPO Roof Membrane should be lapped and seamed using hot air heat welding equipment with an overlap of 80mm. TPO membrane shall be asbestos free, and should have CE marking and BBA approved with life expectancy in excess of 30 years. TPO membrane shall have following minimum properties, (i) Thickness: 1.5 mm membrane system as per EN 1849-2 with -5% & +10% tolerances as per EN 13956. (ii) Tensile strength ≥ 1100 N/5cm as per EN 12311-2; (iii) Tear Resistance ≥ 300 N as per EN 12310-2; (iv) Resistance to impact ≥ 800 mm as per EN 12691; (v) Cold bending of minimum ≤ -40 deg as per EN 495-5; (v) Fire classification – Class E as per EN 13501-1 & EN ISO 11925-2, (vi) Static Puncture Resistance ≥ 20 kg as per EN 12730.

5. Separation Layer: Over waterproofing membrane providing and laying 500 GSM Polypropylene Geotextile on the Surface with 100mm overlap. Geotextile is a high tenacity non-woven needle punctured on both sides made of 100% virgin and high tenacity polypropylene short fibres. Having high tenacity, High resistance to alkalinity and inert towards the various chemical elements present in the soil. and High puncture resistance. Geotextile shall have following properties: Static Puncture Resistance : 7900N; Tensile Strength (DM/DT) : 35/46 KN/m; Elongation (DM/DT) : 75/80%

The entire treatment will be taken upto 30 cm on parapet wall or upto parapet projection (except insulation) as per manufacturer specification.

WATER PROOFING TREATMENT FOR ACCESS CORRIDOR

Providing and applying roof waterproofing with single component pitch modified polyurethane at 1.3mm thickness cures by reaction with atmospheric moisture to give a tough elastomeric waterproof membrane.

Standard compliance: Single component pitch modified polyurethane at 1.3mm thickness meets the requirements of ASTM C836-84

Technical properties:

1	Elongation (ASTM D412) :	>600%
2	Specific gravity :	1.5 to 1.55 g/cc
3	Tensile strength : (ASTM D412)	1.5 N/mm ²
4	Modulus @ 100% elongation (ASTM D412)	0.62 N/mm ²
5	Tear resistance (ASTM D624)	15 N
6	Water vapour transmission for 1.3mm film (ASTM E96)	9.7 g/m ² /24 hrs
7	Permeability (ASTM E96)	0.063 ng/m/sec/Pa*

Chemical properties: Unaffected by a range of mild acids, alkalis and water borne salts and is resistant to biodeterioration.

Instructions for use

Preparation: All surfaces to be waterproofed should be sound, clean and dry.

Concrete surfaces should have a light steel-trowel followed by a fine hair-broom or equivalent finish which is dry and free of dust, oil and other contaminants. All high spots should be removed.

All metal surfaces should be made clean of paint, oils, rust and other contaminants.

Priming: Priming is not normally required on good quality concrete substrates. However, absorbent surfaces such as porous concrete, sand/cement and cement boards will require sealing (as per manufacturers specification) to prevent absorption of polyurethane waterproofing.

Cracks: All shrinkage and non-moving structural cracks should be pretreated with not less than a 1.3mm coating of polyurethane extending 75mm either side of the crack. Allow to cure overnight before general application.

Application: Single component pitch modified polyurethane should be applied by brush, trowel, squeegee or airless spray (two coat application for standard grade on vertical surfaces) at a minimum wet film thickness of 1.3mm (1.3 litre/m²).

If a water test is to be run, the membrane should be fully cured.

Flood test: Prior to placement of protection, flood to a minimum depth of 50mm of water for 24 hours. Drains shall be plugged and barriers placed to contain the water.

Curing and protection: Polyurethane membrane waterproofing must be cured for a minimum of 24 hours @ 25°C before placing protection. Where damage to the membrane is possible (by traffic, backfilling, etc) it should be protected by a cementitious screed or protection boards.

For vertical surface: The entire treatment will be taken upto 30 cm on parapet wall or upto parapet projection as per manufacturer's specification.

WATER PROOFING TREATMENT FOR “BASEMENT”

Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tunnels / subway and bridge deck 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 0.50 mm. 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.

For Horizontal Surface: one coat @1.10 kg per sqm.

For Vertical surface : two coats @ 0.70 kg per sqm.

WATER PROOFING TREATMENT FOR “UNDERGROUND TANK”

For Horizontal Surface: Integral cement-based treatment for water proofing on horizontal surface at all depth below ground level for under ground structures as directed by Engineer-in-Charge and consisting of:

(i) 1st layer of 22 mm to 25 mm thick approved and specified rough stone slab over a 25 mm thick base of cement mortar 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound conforming to IS:2645 in the recommended proportion over the leveling course (leveling coarse to be paid separately). Joints sealed and grouted with cement slurry mixed with water proofing compound.

(ii) 2nd layer of 25 mm thick cement mortar 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportions.

(iii) Finishing top with stone aggregate of 10 mm to 12 mm nominal size spreading @ 8 cum/sqm thoroughly embedded in the 2nd layer.

For Vertical surface : Integral cement based treatment for water proofing on the vertical surface by fixing approved and specified rough Kota stone slab 22 mm to 25 mm thick with cement slurry mixed with water proofing compound conforming to IS:2645 in recommended proportions with a gap of 20 mm (minimum) between stone slabs and the receiving surfaces and filling the gaps with neat cement slurry mixed with water proofing compound and finishing the exterior of stone slab with cement mortar 1:3 (1 cement : 3 coarse sand) 20 mm thick with neat cement punning mixed with water proofing compound in recommended proportion complete at all levels and as directed by Engineer-in-charge.

WATER PROOFING TREATMENT IN SUNKEN PORTION OF WCS, BATHROOM

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.

FIBRE REINFORCED ELASTOMERIC LIQUID WATER PROOFING

Providing and applying fibre reinforced elastomeric liquid water proofing membrane with resilient acrylic polymers having Sun Reflectivity Index (SRI) of 105 on top of concrete roof in three coats @10.76 litre/ 10 sqm. One coat of self-priming of elastomeric waterproofing liquid (dilution with water in the ratio of 3:1) and two coats of undiluted elastomeric waterproofing liquid (dry film thickness of complete application/system not less than 500 microns). The operation shall be carried out after scrapping and properly cleaning the surface to remove loose particles with wire brushes, complete in all respect as per the direction of Engineer-in-Charge.

WATER PROOFING TREATMENT FOR WATER TREATMENT PLANT BUILDING

Water proofing to be done at locations as shown in GFC Drawing.

For Horizontal Surface: Horizontal water proofing shall be 1.2mm thick self-adhesive HDPE membrane conforming to IS 16471 Type I standard for below ground structures having the following technical properties-

Puncture resistance 1000 N ((± 5 to 10%)as per ASTM E 154

Tensile strength of 25 Mpa as per ASTM D412

Elongation of 500% as per ASTM D 412
 Peel adhesion to concrete 880N/m as per ASTM D 903
 45 Days UV Exposure test-Pass.

The system should be fully bonded to the RCC and consists of highly resilient HDPE layer, a pressure sensitive adhesive layer which is covered by a weather proof protective layer. The membrane shall have minimum of 100 mm laps which shall be sealed with double sided adhesive tape. The size of the membrane should not be less than 3 Mtr. x 20 Mtr. to minimize the joints.

All vertical surfaces will be fixed using prefixed gaskets etc. complete as per manufactures specification with 10 years guarantee for waterproofing performance (against leakage, seepage etc) to be given by the principal manufacturer / main supplier for both supply and application.

For Vertical Surface: Horizontal water proofing shall be minimum 1.5 mm thick SBS modified self-adhesive waterproofing membrane topped with impervious, non-perforated HDPE valeron film, for use in retaining walls, confirming to the requirements of ASTM D5147 for thickness with a puncture resistance of >200 N as per ASTM E154. The vital physical and chemical parameters of the membrane shall be as under:

Tensile strength in (L/T) as min 4 N /mm² (as per ASTM D882),

Tear resistance as min 150 N/mm (as per ASTM D 4073),

Peel Strength to concrete as min 2.2 N/mm as per ASTM C 794

Elongation (L/T) % - L-250-300,T- 250-350 (as per ASTM D 882),

Softening point of membrane not less than 105°C (as per IS 1205/1978),

Cold flexibility shall be upto -10°C when tested in accordance with ASTM D 5147

Crack bridging ability - min 1.5mm as per ASTM C 836

The application include cleaning the surface, priming the surface with cold applied bituminous primer, laying the membrane, rolling, properly sealing the joints & maintaining 75 mm overlap between the membrane selvedge & min 100 mm overlap on the end joints of the membrane over the slab etc. complete. HDPE Dimple Protection board 8MM shall be spot bonded on retaining wall before backfilling as per manufacturers specification.

Grading roof for water proofing treatment should be given wherever mention in GFC Drawing

Cement concrete screed 1:2:4 (1 cement: 2 coarse sands: 4graded stone aggregate 20 mm nominal size) to required slope / gradient & thickness as per GFC drawing mixed with water proofing compound conforming to IS:2645 as per manufacturers specification finishing the surface rough to take required flooring over it.

Planters: All Planters floor & wall finish shall be root Resistant Single or Two Component Brush Applied 90% to 100% Polyurethane waterproofing as per manufacturers specification followed by 15 mm thick water proofing plaster cement mortar 1:3 (1 Cement: 3 Coarse sand) admixed with water proofing compound conforming to IS:2645 as per manufacturers specification & drain board. For detail refer GFC drawings.

Providing and applying waterproofing treatment to the planters including cleaning of surface to remove dust, loose particles, etc with compressed air or any other suitable technique depending on site conditions, grinding any sharp edges, etc as per the

instructions of Engineer in charge and post cleaning applying primer over the prepared surface a two part epoxy primer applied at a total consumption rate of 0.25 Kgs/ Sqm broadcasted with quartz sand at a consumption of 0.8-1.0 kgs/Sqm for keying effect. Providing and applying 90% to 100% Solids, Root Resistant, single or two component solvent free cold applied, polyurethane coating waterproofing system at a total consumption rate of 1.2 to 1.5 Kgs/Sqm for 1.2 mm thickness applied in two coats. The waterproofing system should have following system properties. Tensile strength > 2 N/mm² Elongation at break ~ 400%; Abrasion Resistance < 30mg (ASTM D 4060) Shore A Hardness 60 to 75; Application by Roller, Squeeze or Brush.

Lift Pits, Toilet sunken floor, skylight top slab & Gutters: Lift Pits, Toilet sunken floor & Gutters floor & wall finish shall be acrylic cementitious modified two component waterproofing as per manufacturers specification followed by 15 mm thick water proofing plaster cement mortar 1:3 (1 Cement: 3 Coarse sand) admixed with water proofing compound conforming to IS:2645 as per manufacturers specification & drain board. For detail refer GFC drawings.

Cantilever Terraces except Library & Data Center / tertiary pump room terrace: Terrace floor & parapet wall finish shall be acrylic cementitious modified two component waterproofing as per manufacturers specification followed by Brick bat coba waterproofing treatment to required slope/gradient as per drawing & CPWD specification. For detail refer GFC drawings.

Balcony except Library & Data Center: Balcony floor & side treated with acrylic cementitious modified two component waterproofing as per manufacturers specification followed by brick bat coba waterproofing treatment to required slope/gradient as per drawing with average thickness of 120mm and minimum thickness at khurra as 65 mm as per CPWD specification. Finally, all balconies finished with 25 mm thick sand blasted leather finish Rajim or Kadappa stone over 20mm (average) thick base mortar of 1:4. Skirting shall be with 20 mm thick stones over 12mm (average) thick CM 1:3 (1 cement: 3 coarse sand) keeping the joints 4 mm wide & 6 mm deep around & filled with approved quality epoxy grout as per manufacturers specification. For detail refer GFC drawings.

Mumty Slab, Machine room slab & overhead tank, underground tank & Water treatment plant tanks top slab: Mumty Slab, Machine room slab & overhead tank, underground tank & Water treatment plant tanks top slab shall be finished with Brick bat coba waterproofing treatment or as shown in GFC drawing

Parapet Plaster; All parapets inside surface above the waterproofing treatment shall be treated with plaster / paint as per architectural GFC drawing.

Drainboard to be provided wherever mention in GFC Drawing

Providing & laying rolled matrix soil filter cum drainage system of minimum 7-8mm thickness having a compressive strength of > 240 KN/sqm of 8mm height with geotextile on top, as per manufacturers specification, complete as directed.

KHURRA: Making khurras 45cm x 45cm with average minimum thickness of 5cm cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20mm nominal size) finished with 12mm cement plaster 1:3 (1 cement: 3coarse sand) and a coat of neat cement rounding the edges and making and finishing the outlet complete as per GFC drawing or as directed by E-I-C.

INTERNAL FINISHING

All paint finishing 1st quality material should have VOC (Volatile Organic Compound) content less than 50 grams / litre of approved brand, manufacture, colour and shade. Unless otherwise mentioned the consumption of all Paints/Primers & Chemicals shall be as per CPWD DSR/DAR 2018/CPWD Specifications.

All painting material shall be brought to the site of work in the original sealed containers. The material brought to the site of work shall be sufficient for at least 30 days of work. The material shall be kept under the joint custody of contractor and representative of the Engineer-in-Charge.

All internal ceilings shall be plastered with 6 mm cement plaster of mix 1:3 (1 cement: 3 fine sand) except ceiling above false ceiling & exposed RCC finish ceiling as shown in GFC drawings. No plastering shall be done at Ceiling covered with false ceiling.

All junctions of concrete and masonry work and other locations shall be provided with approved galvanized chicken wire mesh (24 gauge 12mm size) fixing in position with galvanized wire nails as per specifications. Providing grooves of necessary size at the junctions as per architectural drawing.

Painting & finishing : All internal walls & all internal Ceiling areas (other than false ceilings) as per schedule of finishes shown in architectural GFC drawings, with premium acrylic emulsion paint of interior grade two or more coats on new work including priming coat to achieve even colour and shade or Acrylic Distemper two or more coats on new work including priming coat to achieve even colour and shade including applying additional coats wherever required to achieve even shade and colour. The painting work commencing after base preparation by white cement based putty (1mm) of approved brand and manufacture over plaster for even and smooth surface.

All staircase walls as per schedule of finishes shown in architectural GFC drawings, shall be finished with three coats (first two coats are with brush and final coat is with roller) of Satin or Matt enamel paint of approved make, desired shade, brand and manufacture, at all heights & levels, to give an even shade, including thoroughly brushing the surface free from mortar droppings and other foreign matter and sand papering smooth. The paint shall be applied after applying a coat of primer of approved brand and preparation of base surface using plaster of paris putty / white cement putty / etc. as applicable or as per manufacturer's specification or as directed by E-I-C..

All service shaft shall be finished with 15 mm thick water proofing plaster in cement mortar 1:3 (1 Cement: 3 Coarse sand) admixed with water proofing compound conforming to IS:2645 as per manufacturers specification & cement paint over water thinnable cement primer as per specifications. All lift well shall be finished with 12 mm thick cement plaster (1:6) & cement paint over water thinnable cement primer as per specifications.

The painting work commencing after base preparation by white cement-based putty (1mm) of approved brand and manufacture over plaster for even and smooth surface.

Wood works (frame, Beading, lipping, etc.) shall be finished with French spirit polish as per specifications and direction of E-I-C wherever required.

MS and MS structural works at all levels shall be finished with acrylic polyurethane paint over two coats of Surface Tolerant Epoxy primer after surface preparation as per given specification.

EXTERNAL FINISHING

There are 4 types of External finishing coming in any building namely Stone wall cladding, Exposed Aggregate plaster, External paint and Exposed RCC Surface.

1. EXPOSED RCC SURFACE

All Exposed RCC surface shall be treated with transparent silicone-based water repellent coating conforming to BS: 6477-1984 in 2 coats with a consumption as per the manufacturer's specification or direction of E-I-C.

2. EXTERIOR PAINT

External surfaces shall be finished with exterior grade acrylic paint if given in drawing at locations specified in the Elevation drawings.

3. EXPOSED AGGREGATE PLASTER

30mm thick exposed aggregate plaster shall be finish in two coats at all levels / height and on all masonry and concrete elements including scaffolding, curing etc. complete as per specifications or as per architectural drawings. All Exposed aggregate plaster shall be treated with transparent silicone-based water repellent coating.

A Sample / Mockup shall be prepared for approval prior to start the work.

HIGH PRESSURE LAMINATES:

Must be 06 mm thick, single/both side decorative, EN 438- Part 6 complying, high pressure laminate panels, which are manufactured by high pressure and temperature in a hot press. The core of the panel consists of desired numbers of imported, long fibre virgin kraft papers, impregnated with specially formulated double hardened Phenolic resin and another top layer of imported virgin Blue wool scale passed, decorative paper layer impregnated with Melamine resin. The panels must be flaming retardant type class 1 as per BS: 476 Part 7, ASTM E84 and EN 438- Part 6. Poly-methyl methacrylate UV protecting films must be provided at the top of the Deco layer

for optimum UV protection (passes 1500 hours). Panels have a tested Flexural Modulus of $\geq 11,000$ MPa and Flexural strength of ≥ 100 MPa which makes the product enormously sturdy from inside. This product must show no distortion in extreme climatic changes such as from -20°C to $+80^{\circ}\text{C}$ or from dry climate to a relative humidity in excess of 85% – 90%. Panels must be equipped with a maximum possible weather resistance at extreme oceanic climates as it has duly passed the salt spray test conducted for 500 hours and pass a 3000 hours artificial weathering and are rated with a 5 for Gray scale rating:

1. 1200X2400 DECORATIVE ANTI VIRAL/ ANTI BACTERIAL /LAMINATE FOR VERTICAL AND HORIZONTAL SURFACE USES (SUEDE FINISH):

1.0mm (1mm +) thick Greenlam or equivalent High Pressure Decorative Laminates (conforming to latest and applicable IS:2046-1995, EN 438:2016 and NEMA LD3-2005 quality standards), made out of, urea free, thermosetting phenolic resins treated Kraft papers as core material and Amino plastic resin treated decor papers on the finish surface. Performance properties of laminates to meet classification HGS for Resistance to surface wear (350 revolutions), Resistance to staining (Rating/Index 5), Resistance to dry heat (180°C -Rating/Index 4), Resistance to cracking (Rating/Index 4) & Resistance to scratching (Rating/Index 3), Resistance to Color Change-Xenon Arch Lamp (Rating 5/Index 6). Colour/Décor, size, thickness and finish of laminates should be finalized according to the specifier's choice and as agreed for supply.

Laminates must have Antibacterial and Antifungal properties (conforming to JIS Z2801:2010 and ASTM G21-2015 standards respectively) and fulfil the applicable indoor air quality certifications, Formaldehyde emission of 0.0073 PPM and Total VOC emission of less than 0.22 milligram per cubic mtr with Greenguard-Gold Certification. Laminate should also have the necessary FSC certification for obtaining LEED points.

Texture, Finish, Design and Shades are as per the choice of Architect and Engineer-in-chief.

2. 1200X2400 GREENLAM CUSTOM DESIGN DIGITAL PRINT HIGH DEFINATION LAMINATE:

1.0mm (1mm +) thick Greenlam Digital High Pressure Decorative Laminates or equivalent (conforming to latest and applicable IS:2046-1995, EN 438:2016 quality standards), made out of, urea free, thermosetting phenolic resins treated Kraft papers as core material and Amino plastic resin treated decor papers on the finish surface.

Performance properties of laminates to meet classification VGS for Resistance to surface wear, Resistance to staining, Resistance to dry heat, Resistance to cracking, & Resistance to scratching. The Décor surface should have Sharp and High Definition Digital print or customized print with superior quality and optimal color intensity. There must not be any smudging of ink, picture or print blur.

Laminates must have Antibacterial and Antifungal properties (conforming to JIS Z2801:2010 and ASTM G21-2015 standards respectively) and fulfil the applicable indoor air quality certifications, Formaldehyde emission of 0.0073 PPM and Total VOC emission of less than 0.22 milligram per cubic mtr with Greenguard-Gold Certification.

Design and shades are as per the choice of Architect and Engineer-in-chief.

3. 1200X2400 GREENLAM FIRE RETARDANT LAMINATE: 1.0mm (+/-0.1mm) thick Greenlam or equivalent High Pressure Decorative Laminates with defined Fire Rating (conforming to latest and applicable IS:2046-1995, EN 438:2016 and NEMA LD3-2005 quality standards), made out of, urea free, fire retardant thermosetting phenolic resins treated Kraft papers as core material and Amino plastic resin treated decor papers on the finish surface. The product must also conform to either or all of Fire Rating norms of CS1D0 when classified in accordance with EN 13501-1: 2007. BS 476-Part 6:1989+A1:2009 and BS 476-Part 7:1997 UL723 - Standard for Surface Burning Characteristics for Building Materials The Fire Retardant Additive must be Halogen free in order to protect environment. Performance properties of laminates to meet classification HGS for Resistance to surface wear (350 revolutions), Resistance to staining (Rating/Index 5), Resistance to dry heat (180°C-Rating/Index 4), Resistance to cracking (Rating/Index 4) & Resistance to scratching (Rating/Index 3), Resistance to Color Change-Xenon Arch Lamp (Rating 5/Index 6). Colour/Décor, size, thickness and finish of laminates should be finalized according to the specifier's choice and as agreed for supply. Laminates must have Antibacterial and Antifungal properties (conforming to JIS Z2801:2010 and ASTM G21-2015 standards respectively) and fulfil the applicable indoor air quality certifications, Formaldehyde emission of 0.0073 PPM and Total VOC emission of less than 0.22 milligram per cubic mtr with Greenguard-Gold Certification.

Design and shades are as per the choice of Architect and Engineer-in-chief.

4. 1300 X 3050 GREENLAM AFX BRAND LAMINATE :

1.0mm (+/-0.1mm) thick Greenlam or equivalent High Pressure Decorative Laminates (conforming to latest and applicable IS:2046-1995, EN 438:2016 and NEMA LD3-2005 quality standards), made out of, urea free, thermosetting phenolic resins treated Kraft papers as core material and Electron beam cured transparent resin treated decor papers on the finish surface. Performance properties of laminates to meet classification HGS for Resistance to surface wear (600 revolutions minimum), ANTI FINGERPRINT PROPERTIES, SELF HEALING ON SCRATCHES, Close to zero reflection GU of 3 ± 1 when measured at an angle of 60 determined according to EN 13722, Resistance to staining (Rating/Index 5), Chemical Resistant as per SEFA Chemical Spot Test (except concentrated sulphuric acid and aqua regia) Resistance to dry heat (180°C-Rating/Index 4), Resistance to cracking (Rating/Index 4) & Resistance to scratching (Rating/Index 4), Resistance to Color Change-Xenon Arch Lamp (Rating 5/Index 6).

Laminates must have Antibacterial and Antifungal properties (conforming to JIS Z2801:2010 and ASTM G21-2015 standards respectively) and fulfil the applicable indoor air quality certifications and VOC emission norms of less than 0.22 PPM with Greenguard-Gold Certification. Laminate should also have the necessary FSC certification for obtaining LEED points.

Design and shades are as per the choice of Architect and Engineer-in-chief

5. 1200X2400 GREENLAM ESD LAMINATES:

1.0mm (1mm +) thick Greenlam ESD Grade or equivalent High Pressure Decorative Laminates (conforming to latest and applicable IS:2046-1995, EN 438:2016 quality standards and possessing performance properties of Electro Static Dissipation), made out of, urea free, thermosetting phenolic resins treated Kraft papers as core material and Amino plastic resin treated decor papers on the finish surface. Resins are modified to impart ESD properties in the final product.

Performance properties of laminates to meet classification HGS for Resistance to surface wear (350 revolutions), Resistance to staining (Rating/Index 5), Resistance to dry heat (180°C- Rating/Index 4), Resistance to cracking (Rating/Index 4) & Resistance to scratching (Rating/Index 3), Resistance to Color Change-Xenon Arch Lamp (Rating 5/Index 6). The value of Surface resistance of the product to have a controlled values of 10⁹ or 10¹⁰ Ω when tested as per IEC 61340& ESD S-4.1, S-20.20. Colour/Décor, size, thickness and finish of laminates should be finalized according to the specifier's choice and as agreed for supply.

Laminates must have Antibacterial and Antifungal properties (conforming to JIS Z2801:2010 and ASTM G21-2015 standards respectively) and fulfil the applicable indoor air quality certifications, Formaldehyde emission of 0.0073 PPM and Total VOC emission of less than 0.22 milligram per cubic mtr with Greenguard-Gold Certification.

Scaffolding : For all exposed plaster work or tile work double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

Preparation of surface: The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced. In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface. Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition concrete surfaces to be plastered shall be pock marked with a pointed tool, at spacings of not more than 5 cm c/c, the pock being made not less than 3 mm deep. This is to ensure a proper key for the plaster. The mortar shall be washed off and surface, cleaned off all oil, grease etc. and well wetted before the plaster is applied.

Materials

Stone Grit: Stone grit shall be free of dust and deleterious material. The grit shall be a combination of broken Dholpur, white marble, bilha & Katni graded stones of 10 mm to 12 mm in proportions as per approved sample Stone grit shall be thoroughly washed with water and sieved before use.

Mortar: Cement mortar for under coat and cement mortar to be mixed with stone grit for top coat shall be as specified.

Bonding Coat: Appropriate bonding coat of approved make shall be done concrete surfaces as per manufacturers specification.

Application of Plaster

12 to 15 mm thick Under Coat : Under coat of cement mortar 1:4 (1 cement : 4 coarse sand) with approved integral waterproofing compound in the proportions recommended by the manufacturer, shall be applied except that the finishing, after the mortar has been brought to level with the wooden straight edge, shall be done with wooden float only. The surface shall be further roughened by furrowing with a scratching tool. Furrowing shall be done diagonally both ways and shall be about 2 mm deep to provide a key for the top coat. The scratched lines shall not be more than 10 cm apart. The surface shall be kept wet till top coat is applied.

15 to 18 mm thick Top Coat : Top layer 15-18 mm thick comprising cement (50% White & 50% grey) and stone grit in mix 1:1.5 (1 cement including 15 percent Marble dust: 1.5 stone grit 10 to 12 mm nominal size) including addition of 15% marble dust to the cement. The top coat is cast in panels by means of wooden beading. The top coat shall be applied a day or two after the under coat has taken the initial set. The surface of the under coat shall be cleaned and a coat of cement slurry at 2 kg of cement per sqm shall be applied before the application of top coat. The top coat shall be applied in uniform thickness on the under coat after the application of slurry and sufficiently pressed with wooden float for proper bonding with the under coat. Vacant space, if any shall be filled with the specified mix.

Finish: The top coat of plaster shall be finished to a true and plumb surface. The surface shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds. All the corners angles and junctions shall be truly vertical or horizontal as the case may be. Rounding or chamfering of corners junctions etc. where required shall be true to template.

Finished surface of the top coat after the mix has taken the initial set, shall be scrubbed and washed with suitable brushes and plain water. Scrubbing and washing shall continue till the stone chippings are sufficiently exposed. Stone chippings which may come out while scrubbing shall be replaced using the specified mortar mix.

Grooves: The aggregate plaster finish shall be laid in panels, grooves of size upto 12mm to 15mm shall be provided with hard wood beading with application of shuttering oil between panels and corners as per Architectural drawing including removal of beading and repairs to the edges of panel. Tapered wooden battens to match the size and shape of the grooves shall be fixed on the under coat with nails before the application of the top coat and these shall be removed carefully so that the edges of the panels of top coat are not damaged. Damage, if any, shall be made good by the contractor.

Cleaning: The entire surface of the aggregate shall be washed with water and with a solution of dilute oxalic acid or hydrochloric acid to remove stains and excess mortar as per the directions of the Engineer-in-charge.

Groove Pointing: All grooves shall be pointed with cement mortar 1:1 (1 cement: 1 coarse sand) mixed with water-proofing compound as per manufacturer's specification to a depth of at least 6mm.

Curing: Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of seven days.

Drip Course : The contractor shall forming drip course in exposed aggregate plaster as called for in the architectural drawings including shuttering & finishing .

Chicken Wire mesh : Providing and fixing Chicken wire mesh 200 mm wide at junction of R.C.C., brickwork, edges, corners, chiseled and repaired brickwork prior to plaster over concealed conduit, etc. shall be as directed by the Engineer-In-Charge or his representative. It shall be considered as part of the work.

4. **STONE WALL CLADDING**

Wherever External stone cladding is shown in GFC drawings, all external walls shall be finished with 15 mm cement plaster in Cement Mortar 1:4 (1 Cement: 4 coarse sand) with water proof compound prior to the stone cladding.

Stone shall be of the type as specified in the item / Drawings. It shall be hard, sound durable and tough free from cracks, decay and weathering and defects like cavities cracks, flaws, holes, veins patches of soft or loose materials etc. Thickness of stone shall be minimum 30 mm or as specified in drawing. Samples of each item of stone work either individually or in combination shall be prepared for approval of Engineer-in-Charge before commencement of work.

Stone shall be machine cut to the required size and shape on all beds and joints so as to be free from any waviness and to give truly vertical horizontal surface as required. The exposed face and sides of stones forming joints shall be such that the straight edge laid along the face of the stone is in contact with every point on it. All the visible angle and edges shall be square and free from chipping. The dressed stone shall be 30 mm thick as specified with permissible tolerance of + 2 mm.

Before starting the work, the contractor shall get the samples of stone approved by Engineer-Incharge. Approved sample shall be kept in custody of Engineer-in-Charge and stones supplied and used on the work shall conform to sample with regard to soundness, colour, veining and general texture. The stone shall be cut by gang saw into slabs of required thickness along the places parallel to the natural bed. When necessary double scaffolding for fixing the stone at greater heights, jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stone and placed them into correct positions. Care shall have to be taken that corners of the stone are not damaged. Stone shall be covered with gunny bags before tying chain or rope is passed over and it shall be handled carefully. No pieces which has been damaged shall be used that work

Stacking and Storing

Stone slabs are thin and brittle and should never be stacked flat across timber supports. They should therefore, be stacked on edge on timber or like runners. Packing pieces inserted between the slabs may be rope or timber. Slabs shall be well covered with plastic sheeting to protect them from any possible staining.

Scaffolding

Double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

Fixing

The size & shape of the cramps shall be as per drawing and as per directions of Engineer-in-charge. The samples of steel cramps should be approved in advance before starting the stone cladding work. The cramp shall be attached to top and bottom of the stone. The cramps shall have inbuilt adjustment for vertical and horizontal alignment. The cramps used to hold support and transfer the load of stone unit to the supporting structured steel shall be designed by the manufacturer and approval of the same shall be obtained from the Engineer-in-Charge. The minimum number of clamps required shall be as per requirement of design to carry the load of individual stone slabs. The cramps shall be spaced with provision for insertion of pins / bolt attached with the stainless steel cramps along the sides of the stone as per GFC drawing. Adequate cutting in stone shall be made with precision instruments to hold the cramps pins at the joints. Stone shall be secured with clamps with high quality workmanship. The walls shall be carried up truly plumb. All the courses shall be laid truly horizontal and all the vertical joints truly vertical. The sequence of execution for cladding work shall be approved by the Engineer-in-Charge/ Architect.

The cramps shall be of stainless steel grade 316 of approved make. The size & shape of the cramps shall be as per drawing and as per directions of Engineer-in-charge / Architect. The samples of stainless steel grade 316 cramps should be approved in advance before starting the stone cladding work. The cramp shall be attached to top and bottom of the stone. The cramps shall have inbuilt adjustment for vertical and horizontal alignment. The cramps used to support and transfer the load of stone to the supporting structure and approval of the same shall be obtained from the Engineer-in-Charge.

The stone shall break joints on the face of the wall unless otherwise shown in the drawings. The stone shall be in regular courses as per drawing and all stones shall be of the size mentioned in the drawing also with grooves where ever mentioned.

Jointing

The thickness of joints shall be as small as possible, not exceeding as specified in drawing. The fine joint shall be uniform throughout. Joints horizontal and vertical shall be filled with weather sealant of make & colour as approved by Engineer-in-charge with the help of pouring gun for filling the sealant. Before filling the joint with sealant, masking tape are required to be fixed on stones surface on both edges of joints

of the stones, so that sealant may not spoil the surface of the stone. When all the joints are filled and sealant has dried, the masking tape may be removed.

Protection

Work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage and rain during construction. All Exposed surface of stone shall be treated with transparent silicone-based water repellent coating.

Materials:

Gang-saw cut Bilha stone : 1st Quality locally best available as approved by EIC

Rough Bilha stone : 1st Quality locally best available as approved by EIC

Polished Mandana stone : 1st Quality as approved by EIC

Stainless Steel Clamps: All clamps / cramps shall be of stainless steel grade 316. The clamp weight shall be minimum 250gms. The clamp body shall be of minimum 5mm thickness and shall be able to carry a dead load of 79.5 kgs at minimum offset. The clamp shall be offset lengths from 50-65mm. Test certificate shall be submitted by the manufacturer, if required. Clamps shall be fastened by M10X90 Stainless Steel grade (316) mechanical torque controlled Stud anchor (on concrete). Anchor should be pre-assembled with a stud, expansion sleeve, a nut and a washer. Top end of stud should contain threads and bottom end should be cold formed conical head . / M10X100 Stainless Steel grade (316) (on bricks/aerated blocks) . Anchor should possess ETA approval and comprises of polyamide PA 6 grade sleeve and stainless steel A4 (316) grade double threaded screw with hexagonal head. Fixing methodology should be followed as per manufacturer guidelines. The contractor have to arrange onsite pull out test of clamps/cramps from the manufacturer.

Important note:-It will be responsibility of Contractor alone to ensure that each and every Cladding stone and clamp is well installed as per CPWD Specs or relevant code/practice and if any mishap/unfortunate incident happens during execution of work or in future after completion of work/agreement due to falling of stone etc, then Contractor will be solely responsible.

Silicone based water repellent coating on External Finishes

Silicone based water repellent coating on exposed RCC surface, exposed stone surface of wall cladding and exposed aggregate plaster.

Providing and applying silicone based water repellent coating confirming to BS: 6477-1984 in 2 coats with a consumption as per the manufacturer specification or as approved by E.I.C.

The silicone-based water repellent coating should have the below mentioned technical properties-

Property	Typical Value
Appearance	Clear free flowing liquid
Colour	Water white to pale yellow
Nonvolatile matter %	3.5-5.0
Surface dry times in minutes	20-25
Water repellency as per IS 12027:1987	Repel water in bead form
Specific gravity@30-degree gms/ml	0.80+0.02

Surface Preparation

Surface should be dry and free from all debris, dirt, oil, grease, wax and all other contamination, which could prevent penetration.

Clean the saturated dirt of surface by thorough wire brushing, cleaning with compressed air followed by water washing.

De grease oil & grease by using appropriate solvents.

Allow the surface to dry completely before the application.

Thorough wire brushing followed by sanding with emery paper is recommended

Application

Apply one liberal coat of silicone coating confirming to BS: 6477-1984 simply by brushing evenly on the prepared surface.

Allow the surface to dry for a minimum of 24 hrs for best results.

Allow it to dry for 24 hrs.

Apply second coat wet on wet, to improve the penetration rate & performance.

Allow it to dry for 24 hrs.

Do not dilute with water or by any other means.

The coating should be applied in 2 coats with a consumption as per Manufacturer specification or as per DSR.

5. DRY STONE CLADDING

Material

Stone shall be of the type as specified in the item. It shall be hard, sound durable and tough free from cracks, decay and weathering and defects like cavities cracks, flaws, holes, veins, patches of soft or loose materials etc. Thickness of stone shall be as specified Stone shall be cut with the gang saw to the required size and shape on all beds and joints so as to free from any waviness and to give truly vertical horizontal surface as required. The exposed face and

sides of stones forming joints shall be such that the straight edge laid along the face of the stone is in contact with every point on it. All the visible angle and edges shall be square and free from chipping. The dressed stone shall be of the thickness specified with permissible tolerance of + 2 mm. Before starting the work, the contractor shall get the samples of stone approved by Engineer-Incharge. Approved sample shall be kept in custody of Engineer-in-Charge and stones supplied and used on the work shall conform to sample with regard to soundness, colour, veining and general texture. The stone shall be cut by gang saw into slabs of required thickness along the places parallel to the natural bed. When necessary double scaffolding for fixing the stone at greater heights, jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stone and placed them into correct

positions. Care shall have to be taken that corners of the stone are not damaged. Stone shall be covered with gunny bags before tying chain or rope is passed over and it shall be handled carefully. No pieces which has been damaged shall be used that work

Stacking and Storing

Stone slabs are thin and brittle and should never be stacked flat across timber supports. They should therefore, be stacked on edge on timber or like runners. Packing pieces inserted between the slabs may be rope or timber. Slabs shall be well covered with plastic sheeting to protect them from any possible staining.

Scaffolding

Double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

Fixing

The size & shape of the cramps shall be as per drawing and as per directions of Engineer-in-charge. The samples of steel cramps should be approved in advance before starting the stone cladding work. The cramp shall be attached to top and bottom of the stone. The cramps shall have inbuilt adjustment for vertical and horizontal alignment. The cramps used to hold support and transfer the load of stone unit to the supporting structured steel shall be designed by the manufacturer and approval of the same shall be obtained from the Engineer-in-Charge. The minimum number of clamps required shall be as per requirement of design to carry the load of individual stone slabs. The cramps shall be spaced not more than 60 cm horizontally and vertically along the stone side for insertion of pins / bolt attached with the steel cramps. Adequate cutting in stone shall be made with precision instrument to hold the cramps pins at the joints. Stone shall be secured with clamps with high quality workmanship. The walls shall be carried up truly plumb. All the courses shall be laid truly horizontal and all the vertical joints truly vertical. The sequence of execution for cladding work shall be approved by the Engineer-in-Charge.

Jointing: Joints horizontal and vertical shall be filled with weather sealant of make as approved by Engineer-in-charge with the help of pouring gun for filling the sealant. Before filling the joint with sealant, masking tape are required to be fixed on stones surface on both edges of joints of the stones, so that sealant may not spoil the surface

of the stone. When all the joints are filled and sealant has dried, the masking tape may be removed.

Protection: Work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage and rain during construction.

Measurement: The length and breadth shall be measured correct to a cm. The area shall be calculated in square metre correct to two places of decimal. Any opening of area 0.01 sqm. or less shall not be deducted.

STRUCTURAL STEEL FRAME WORK FOR DRY STONE CLADDING

Specification for structural frame work for dry stone cladding are same specifications as for steel work in built up sections (welded or bolted).

Fixing of Frame

The properly designed structural frame for withstanding the weight of stone slab are fixed/supported on wall surface with the help of M.S. brackets/lugs of angle iron/flat etc. which is welded at each junction of member of frame and also embedded in cement concrete block 1:2:4 (1 cement: 2 coarse sands: 4 graded stone aggregate 20 mm nominal size) of size 300 x 230 x 300 mm. The concrete block can be made by cutting the hole of size as mentioned in brick wall and filling the hole with cement

concrete including provision of necessary centring/shuttering for holding of concrete. The frame can also be supported on RCC surface with the help of approved expansion hold fastener by drilling the holes in RCC surface. Steel cramps are either welded or bolted to the frame (by making necessary holes in frame work) for holding of stone.

ADJUSTABLE STAINLESS-STEEL CRAMPS

The cramps shall be stainless steel of make approved by the Engineer-in-charge.

- The weight of the stainless-steel clamp (including weight of nut and washer) shall not be less than 260 gms.
- Necessary holes at suitable locations are to be done on steel frame work for dry stone cladding to be fixed.
- Necessary recessed are required to be done in stone slab which is required to be supported by clamps.
- The one end of steel clamp is fixed on frame with nut and bolt and other end is inserted into recesses/hole for fixing the dry cladding stone on frame.
- The rate includes cost of materials and other operations mentioned as above.

SOME ITEMS OF ANCILLIARY BUILDING'S

Machine / Equipment foundation : Machine / Equipment foundation of any shape, size & design as per manufacturer / supplier / GFC drawing shall be Ready mixed M-30 / M-35 grade concrete as per GFC drawing including necessary centering / shuttering, reinforcement steel, making necessary pockets of required size and shape (by providing moulds of required shape & size), fixing insert plates / pipes etc. in line, level and plumb complete as per drawing and grouting the same with cement concrete of richer mix and finishing, curing etc. complete as directed. Base concrete below the machine foundation shall be of grade 1:4:8 of 75 mm thickness or as per GFC drawing.

Cable Trenches: Foundation / base slabs & walls of trenches shall be Ready mixed M-30 grade concrete including reinforcement steel as per structural GFC drawing. Base concrete below the trenches base slab shall be of grade 1:4:8 of 75 mm thickness or as per GFC drawing. Top of all trenches shall be covered with 6 mm thick chequered plate supported on M.S. angle nosing / cross support with holdfast embedded in trench RCC wall as per detail given in GFC drawing. Floor & walls of trenches shall be finished with acrylic cementitious modified two component waterproofing as per manufacturers specification followed by 15 mm thick water proofing plaster in cement mortar 1:3 (1 Cement: 3 Coarse sand) admixed with water proofing compound conforming to IS:2645 as per manufacturers specification & cement paint over water thinnable cement primer as per specifications. For detail refer GFC drawings.

Eco Ventilators: Providing & fixing roof air ventilator assembly with base ring 24" ID (600mm) & 32" OD (800mm) Eco friendly SS construction with FRP Venture dome thickness 1.5 mm and transparent in colour. Central shaft will be made of bright bar material with internal arrangement of metlon bushing bottom ring & top of SS 304 Grade and 36 Nos turbine vanes in SS construction etc. complete as per manufacturers specification or as directed by E-I-C.

Water storage Tanks : Polyethylene water storage tank, IS : 12701 marked, of capacity as per GFC drawing & of approved make & colour, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes including fittings and the base support for tank shall be provided at Security Complex & Security Cabin 1, 2A, 2B & Main Receiving Sub Station terrace .

Rolling shutters : Rolling shutters shall be of approved make, made of 80x1.25 mm size M.S. laths, interlocked together through their 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 mechanical device chain and crank operation for operating rolling shutters complete, including providing and fixing necessary 27.5 cm long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 - part 1, ball bearing & M.S. top cover 1.25 mm thick for rolling shutters . Rolling shutters shall be partly grilled or partly fixed as per architectural GFC drawing. Grilled rolling shutters manufactured out of 8 mm dia M.S. bar instead of laths as per design approved by Engineer-in- charge.

G.I. chain link fabric fencing: G.I. chain link fabric fencing of height 1.2 m & gate of height 1.8 m in mesh size 50x50 & G.I. wire of dia 4 mm shall be provided at Transformer yard encloser complete as per detail given in GFC or as per the direction of Engineer-in-charge. G.I. chain link fabric fencing shall be fixed as per the detail given below :

- a) Providing and fixing vertical post fabricated out of 2 nos. 50 x 50 x 6mm MS angles, 1.8 meter long with 150 x 150 x 6 mm thick base plate, at spacing as per GFC drawing, 500 mm grouted in toe wall in cc 1:2:4 block of size 230 x 230 x 500 mm.
- b) To form rectangular panel, frame out of ISA 50 x 50 x 6, of size as per drawing, welded to vertical posts by means of 4nos box cleats of ISA50x50x6 (2nos on either side), with necessary welding, nuts and bolts and washers, if required, etc complete.
- c) Chain link of size 50mm x 50mm, covering the panels of MS angles, fixed with 32 x 6 mm MS flat as beading, with making necessary holes and fixing with 10 mm dia 40 mm bolts with washers, nuts etc. complete.
- d) Gate shall be fabricated as per detail given in GFC drawings including required heavy duty hinges, aldrops& tower bolts complete as directed by Engineer-in-Charge
- e) Painting the vertical posts , chain link panel etc. with polyurethane paint as per manufacturers specification.

Basement Floor Drain : Floor drain of size, slope & details shall be made as per GFC drawings in pump room & miscellaneous water tanks in Under Ground Tank (UGT) & Water Treatment Plant (WTP). All drains floor & walls shall be finished with 15 mm to 20 mm thick water proofing plaster in cement mortar 1:3 (1 Cement : 3 Coarse sand) admixed with water proofing compound conforming to IS:2645 as per manufacturers specification & floating coat of neat cement. Top of floor drain shall covered with M.S. grating of size & detail as per GFC drawing & finished with polyurethane paint as per manufacturers specification.

Leveling for Basement flooring : Cement Concrete 1:2:4 or as mentioned in GFC drawing shall be filled below pump room & other area flooring in slope as per detail given in drawing or as directed by Architect / E-I-C.

MS Structural Steel work

Structural steel of grade E250 confirming to IS2062 shall be used for M.S. Steel ladder, M.S. Hand rail, M.S. Insert Plates / Base / gusset / stiffener plates as per Architectural / Structural drawings. M.S. Tube (Pipe / square / rectangular) sections shall be of grade E310 for Pipes / E350 for RHS & SHS shall be used for Architectural Pergolas, Façade members if any as per corresponding Architectural / Structural drawings.

All cable trenches shall be covered with 6 mm thick chequered plate supported on M.S. angle nosing (not less than angle 40 x 40 x 6mm) / M.S. angle cross support with holdfast embedded in trench RCC wall as per detail given in GFC drawing.

All railings including staircases, spiral staircase , around cutouts , terraces etc., shall be MS railing as per drawing including Fire escape stair if any. MS works in Monkey

ladder for O.H.T., machine Room terrace, Mumty, terrace & Plumbing shaft as per architectural drawing.

MS supports (angle, tube, channel, etc.) at wall / ceiling for services (Plumbing, Electrical, HVAC, etc.) shall be provided as per approved shop drawing, design and direction of E-I-C. MS supports to be fixed with 100x8 mm anchor fasteners in concrete / hold fast with M15 concrete block in brick work in adequate no. of spacing.

M. S. Gate : MS gate in Telephone exchange enclosure wall / M.S. gate & grills in Security Complex main entrance & pedestrian entrance / M.S. gate & grills in Security Cabin 1, 2A & 2B main entrance & pedestrian entrance shall be fabricate & fixed as per detail given in GFC drawing including polyurethane paint, all required hardware, MS heavy duty hinges etc., all completed as directed by Architect / E-I-C.

M.S. Gratings : Top of floor drain shall covered with M.S. grating of size & detail as per GFC drawing & finished with polyurethane paint as per manufacturers specification. Locations : UGT & WTP

Painting & finishing of Steel work : All MS structural steel works shall be finished acrylic aliphatic polyurethane paint as per specification

Under Ground Tank (UGT) / Water Treatment Plant (WTP) / Over Head Tanks

PVC water stops to be compulsorily provided at the construction joint during casting of wall of watertank and waterproofing compound shall be mixed in Concreting and plastering of all tanks as per direction of E-I-C in proportion recommended by manufactures

Providing PVC water stops 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 with Serrated central bulb (225 mm wide, 8-11 mm thick), all complete as per E-I-C.

Internal floor & wall finish of all tanks in UGT & WTP / Soft Water Tank in Electric Sub Station & Plant Room, Academic Area shall be acrylic cementitious modified two component waterproofing as per manufacturers specification finished with 300x300mm glazed Ceramic tiles over 12 mm thick bed of cement mortar 1:3 (1 Cement: 3 Coarse sand) and jointed with grey cement slurry @ 3.3 Kg per sqm including pointing in white cement mixed with pigment of matching shade. For detail refer GFC drawings.

Under Ground Tank (UGT) / Water Treatment Plant (WTP) / Over Head Tanks top cover shall be 455 X 610 mm rectangular double seal C.I. Cover with frame (light duty) including lockable arrangement, the total weight of cover and frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg.) or 500 mm internal diameter double seal circular manhole cover with frame (medium duty) including lockable arrangement, total weight of cover and frame to be not less than 116 kg (weight of cover 58 kg and weight of frame 58 kg) as shown in GFC drawing, Rungs shall be 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 mm x 25 mm and over all minimum length 263mm and width as 165mm with minimum 112mm space between protruded legs having 2mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138mm as per standard drawing or as per CPWD specification.

Spouts / sleeves: Wherever shown in Drawings or as required GI spouts / sleeves of diameter as per GFC drawing, average 400 mm long or as required shall be fixed at all levels and locations including cutting & making good the walls / concrete with primer & painting complete as shown in drawing or as directed by E-I-C.

Crash Rail: Supply & apply Crash rail with 203 mm face dimension, Product to be supplied in 3000 mm Lengths with standard end Cap.

A. Engineered PVC Crash Rails to be Acrovyn: Surface mounted assembly consisting of standard aluminum clips with snap-on Acrovyn 2000 cover and integral shock absorbing cushions. End caps shall be mechanically fastened with concealed fasteners. Color matched end caps and corners shall be removable for ease of replacement,: Extruded material should be high-impact Acrovyn 2000 with Shadowgrain texture, nominal .1.98mm thickness. Colors to be indicated in the finish schedule from one of manufacturer's available colors and patterns.

B. Regrind PVC: PVC-PVC regrind absorption cushion.

C. Aluminum: Extruded aluminum should be 6063-T6 alloy.

Crash Guard: Supply & apply of SCR 50 Surface mounted crashrail, 127 mm deep. Product to be supplied in 3000 mm lengths. With Standard End Cap Regrind PVC: PVC-PVC regrind absorption cushion. Aluminum: Extruded aluminum should be 6063-T6 alloy, nominal thickness. Minimum strength and durability properties as specified in ASTM B221

Corner Guard: Supply & apply of SM20 90 degree, surface mounted corner guard, 76 mm legs, aluminum retainer, caps included. Cut sizes and quantities to be listed below. SM20N. PVC regrind absorption cushion. Aluminum: Extruded aluminum should be 6063-T6 alloy, nominal thickness. Minimum strength and durability properties as specified in ASTM B221

MODULAR PARTITION WORKS

GYPSUM BOARD PARTITIONS:

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. 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) Glass reinforced Gypsum (GRG) plaster board 12.5 mm thick confirming to IS 2095 (Part 3):1996

Insulation with Resin Bonded rock wool:

Resin Bonded rock wool conforming to IS: 8183, having density 48 kg/m³, 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.

MODULAR GLASS PARTITION:

12mm toughened glass with proprietary Slimline partition systems of as per Manufacturers specification as verticals and horizontals at top and bottom with option for installing glass & glass to glass joint with other required accessories as per the drawing and instructions of the Architects.

The rate shall include all design, Providing & fixing Printed frosting film of 3M make of crystal range with approved image printed on the film as per design & installed over the glass partition as per manufacturer's specification & installation guidelines. Vendor shall include wastage while quoting. Vendor shall provide 10 year warranty as per manufacturer's guidelines.

FROSTING FILM HEIGHT OF 750MM

MISCELLANEOUS ITEMS

CLEAN ROOM ITEMS

Modular Wall Panel : Supply and installation of 80 mm thick double skin modular wall panel system made of 0.8 mm thick Powder coated (60-80 microns) GPSP sheet on both sides over an aluminium frame work with sealed and insulated interior, PUF (Class O rating) as a infill material of density 40 +/- 2 kg/m³ is sandwiched between the two skins and sealed from the exterior by the aluminium frame work, GI floor profiles with leveling adjustment are provided for reinforcement along the periphery and accommodate the Epoxy/ vinyl floor flush with wall panels. The wall panels are constructed with an interior Aluminium frame work for self supporting. Partition to Partition connections are maintained with precision with aluminium profiles that create uniform seams. wall panels are inter changeable with doors & vision Panel, special fasteners and profiles are provided for easily dismantable. The Partition seams are sealed by silicone food grade sealant with a perfectly flush finishing. The panel will come with prefabricated cutouts for switch sockets with proper flashing & sealing of cutouts as well as inclusive of PVC Heavy Grade conduit of 3 metre length having outer dia. of 32 mm. Both sides of panels provided with protective film to prevent surface damage during shipping and installation.

Walkable False Ceiling: Supply and installation of 50mm thick double skin totally flush walkable false ceiling panel made of 0.8mm thick powder coated (60-80microns) GPSP sheet on both side over an aluminium frame work with sealed and insulated interior, PUF (Class O rating) as a infill material of density 40 +/- 2 kg/m³ is sandwiched between the two skins and sealed from the exterior by the aluminium frame work. The ceiling panel system comprise of aluminium ceiling grid suitable for easy installation, load bearing, flushed to the ceiling panels, Indexing screws for easy mounting of the system, reinforcing clamps and brackets, turn buckles & threaded rods are fastened to the overhead support at fixed intervals and other hardware for easy & faster leveling of the system etc. All the suspension material is of Galvanized finish. Panel to Panel connections are maintained with precision with aluminium profiles that create uniform seams. The Partition seams are sealed by silicone food grade sealant with a perfectly flush finishing. The panel will come with prefabricated cutouts for light fixtures & Hepa filters with proper flashing & sealing of cutouts as well as inclusive of PVC Heavy Grade

conduit of 3 metre length having outer dia. of 32 mm. Both sides of panels provided with protective film to prevent surface damage during shipping and installation.

Doors : Supply and installation of 46 mm thick both side flush doors of size as per drawing, made of 0.8 mm thick PU painted GPSP sheet with PUF as a infill material of density 40 +/- 2 kg/m³ is sandwiched between the two skins, 1.2 mm thick standard 50mm frame width GPSP powder coated door frames totally flush with the wall

panels, necessary hardware like stainless steel hinges, stainless steel 'D' type of handles on pull side, stainless steel push plates on push side, Dorma TS 71 door closers or equivalent, Dead lock with both side key operation, double glazed view glass of standard size with self adhesive tape & food grade silicon sealant, SS ball bearing butt hinges, kick plate and concealed automatic door bottom seal etc.

Coving : Supply and installation of extruded aluminium powder coated covings of R50 to fill the gap between wall panel to false ceiling and also between wall panel to wall panel at corners.

1. Covings for wall to ceiling & wall to wall
2. 3D internal & external

View Panels : Supply and installation of view / glazed panels with flush design & size as per drawing. The view panels provided with 6mm thick float glass on both sides with flush design, necessary gaskets, food grade silicon sealants and all required accessories.

In-built Return Air riser : Supply and installation of In-built Return Air Risers made of GPSP sheets in 80mm thick wall panels with 150mm projection at the top of ceiling. The scope includes necessary stiffeners, flange connections to connect Ducting, permanent magnet/ mechanical holding system to hold the perforated grills on Risers, fixing screws etc.

1. Inbuilt RAR with collar projected 150 mm above the panel and with flange to connect duct

Return Air Risers grills : Supply and installation of Return Air Risers grills (Powder coated) complete as per manufacturers specification or as directed by Engineer - in - Charge.

Pre filter for Return Air Risers : Supply and installation of Pre filter for Return Air Risers (G-4) complete as per manufacturers specification or as directed by Engineer - in - Charge.

Epoxy flooring : Epoxy flooring for clean room shall be 3mm thick Epoxy Self Leveling Flooring which include Solvent Free Epoxy Primer, along with top coat in 3mm Thickness (Self Leveling Epoxy Top Coat) having minimum compressive strength of 55N/sqmm and Flexural Strength of 31N/sqmm and Tensile Strength of 18N/sqmm (Must satisfy requirements classified under BS 6319) in approved color on Concrete VDF floor / IPS floor. Surface preparation should be done mechanically with Diamond Grinder or scarifier complete as per manufacturers Specification

Air Shower : Supply, installation, testing and commissioning of air shower made of 16 gauge SS 304 sheet on both sides and working area of 2000mm(W) x 1300mm (D) x 2400mm (H). The air shower comprise return air collection at bottom with EU-4

pre-filter & perforated GI powder coated grill, fan with adequate static pressure & EFF-1 class motor, HEPA filter section with EU-13/14 grade HEPA filters of 99.995% efficiency down to 0.3 particles, air outlet chamber with SS air nozzles and air velocity through nozzles to be 20- 22 m/s to ensure efficient scrubbing action necessary to remove particulate matter, vinyl flooring with conductive and antistatic properties, cleanroom compatible Doors with sandwich type construction, view panels and light fixture, microprocessor controller to supervise all functions, emergency stop buttons on both sides of shower, indicator lights on both sides of shower exterior to control traffic flow in & out of cleanroom. Air shower is designed to meet minimum of 370 ACPH, minimum of 6 nozzles for proposed working area, fully tested and certified in compliance with ISO 5 class as per ISO -14644- 2&3 and IES-RP-CC-002-86.

SUN LOUVER SYSTEM

Double Fin Rectangular Sun Louver System : Supply & fixing of Double Fixed Double Fin Rectangular Sun Louver System of size 50mm thick X 450mm depth consisting of extruded aluminium square shaft & butterfly clamps covered with aluminium metal cover skin on both sides, rectangular shaped aluminium fin skin with crowning manufactured out of 0.7mm aluminium alloy AA3005 fixed on both sides of square shaft, fin bearing block, axle, axle lock, nylon end cap, end cap screws, and end cap connector & accessories for fixed system. The maximum module of fin for fixed system is 390mm and the length of fin shall be determined based on the wind load calculation and deflection, subject to a maximum length of 3.5 M (for horizontal application) & up to a maximum length of 4 M (for vertical Application). The factory assembled Double rectangular 400mm fin will be fixed on both ends to suitable Installation frames of MS sections/Aluminium provided by the contractor. The installation frame shall be fixed mechanically to concrete structure with MS or Aluminium brackets. The erected substructure shall be aligned within the tolerances of span/1000 of plumb line and level with a non-cumulative tolerance of a maximum of 2 mm. The louver Fin skin shall be coil coated in PVDF finish suitable for exterior applications.

AUTOMATIC SLIDING DOOR OPERATOR

Providing and fixing automatic bi-parting sliding doors with 12mm clear toughened glass shutter.

Automatic sliding door operator shall be as per approved dwg., Compliant with European standards and produced according to the guidelines for power-operated windows, doors and gates, BGR 232, the UVV and the VDE regulations. TÜV design tested, tested according to the low voltage guidelines, fulfils DIN 18650 standards for Pedestrian Safety, TÜV Design Tested for Durability of 1 million Cycles. The track profile should be separate from the main profile for enabling reduction in vibration insulation. Operator length = 6250 mm, Maximum clear passage opening width = 3000 mm, maximum clear passage height = 2500 mm, includes micro processor controlled drive unit, with self learning mechanism, program selector with knob, motion detector (eagle 6 radars, 02 nos), mechanical components, toothed belt, cover

profile, floor guide for frameless glass (02 nos), glass clamping rail (02 nos), safety device-light barrier (01 pair). Body finish : standard silver anodised operator profile, electromechanical lock with 12 mm plain toughened frameless glass for complete elevation - 2 moving panels. UPS of 750 VA shall be provided, which will give power backup of 20 min. Only & if the duration of power cut to the operator is more than 30 min., then separate arrangement needs to be done for the same as automatic operator requires uninterrupted stabilized power supply. The above work complete in all respect as per approved shop drawings and to the satisfaction of engineer-in-charge / architect consultant.

FRAME LESS DOOR

Providing & fixing manual frameless double leaf glass doors with 12 mm clear toughened glass and S/S patch fitting (PT standard) of grade 304 : such as Top pivot, Top patch, Bottom patch, Corner lock with EPC, lock keeper plate & stainless steel grade 304 handles 38 mm dia and 600 mm long or as approved by the Engineer in charge and floor spring conforming to DIN EN1154 with adjustable spring strength EN(1-4) and Tested for durability of 500,000 cycles.. The above work complete in all respect as per approved shop drawings and to the satisfaction of engineer-in-charge.

GLAZED PARTITIONS

Supply and Fixing of Full Height demountable Glass partition including doors with 10mm Toughened Glass using Frame profiles 100 x 25 mm upto a height of maximum 4m or as per drawing using minimum 20 micron matt finished Anodised Aluminium in required colour & shade. The Fixed glass to be fixed using base profiles 100 x 25 mm at Top & Bottom & support profile 100 x 25 mm at sides. The profile size to be 100x25MM to be fixed on to the floor/wall/ ceiling as per the architect design. Over panel Profile of **100 x 50 mm** to be used for Over panel, H Junction profile to be used at all Glass to Glass vertical joints, 90 Deg L Junction Profiles and T Junction profiles necessary as per design. End Profile 100 x 25 mm to be used for Open glass edges and all around the door frame with seals and Over Panel End profile including filling the joints if required with Silicon sealant structural grade and weathering grade of Dow corning - USA or "GE Silicon - USA" or "WACKER - Germany", complete as per detailed drawings & approved shop drawings. (The contractor must provide detailed shop drawings of individual profiles and also details of any other profiles that may be used clearly indicating all dimensions.)

The Profile shall be matt natural anodized, the Profile Manufacturer to supply all the necessary clips, seals and fixing accessories for the system. All Profiles to be with 2 mm Gauge thickness .

Hardware for Glazed Partition single or double leaf doors

Providing & fixing approved make stainless steel grade 304 patch fitting in frameless glass single or double leaf door shutters which include Top pivot, Top patch, Bottom patch, Corner lock with EPC, lock keeper plate and 'H' shape pull handle (450 mm x 25 mm) SS 304 grade and floor spring with adjustable spring strength, suitable for door leaf weight upto 120 kgs, max leaf width 1100mm and Tested for durability of 500,000 cycles & other accessories including the cost of screw & all other incidentals complete as per detailed drawings & approved shop drawings.

Glass Block

Glass Blocks (transparent / colour) of approved make of size 190mm x 190mm x 80mm (approximate weight 2.0-2.5 kg per block) with 10 mm joint to achieve a 200 mm module with mortar grout of white cement and marble powder in proportion of 1: 2 respectively including 6mm dia steel reinforcement bars to be laid in horizontal and vertical joints as per manufacturers specification.

Glass block panels shall be supported on all sides by fabricated powder coated (minimum thickness of powder coating 60 micron) aluminium frames of nominal dimension 80mm x 40mm x 2mm size, and block should rest on top of the cement mortar 1:3 (1 cement : 3 sand). Aluminium frames shall not be load-bearing and shall be fixed to the surrounding structure.

The joints between the blocks to be sealed with transparent / colour Silicon Gel sealant of approved make complete as per manufacturer specification, as per drawing and instructions of the Architect.

Location: Glass block shall be provided at various location & levels as per GFC architectural drawing.

PRECAST CEMENT CONCRETE JALI

The jali shall be of cement concrete 1:2:4 (1 cement 2 coarse sand:4 stone aggregate 6 mm nominal size) reinforced with 1.6 mm thick mild steel wire, unless otherwise specified including centering and shuttering, roughening cleaning & fixing.

The jali shall be set in position true to plumb and level before the joints sills and soffits of the openings are plastered. It shall then be properly grouted with cement mortar 1:3 (1 cement :3 coarse sand) and rechecked for levels. Finally the jambs, sills and soffits shall be plastered embedding the jali uniformly on all sides.

GRC Customized Moulding/Cornice/Panel casted with Power Spray methodology

Glass Reinforced Concrete (G.R.C) Moulding / Cornice / Panel in approved size, pattern, design, shade and thickness of 50mm on frame and internal member in 18 – 20mm thick casted with layering technique Power Spray methodology have weight approximately between 5 – 7 Kg per Sq. Ft. and color of approved make. The moulding / cornice / Panel should be made from '53 grade' White Portland Cement, Fine graded Quartz & Silica Sand, Alkali Resistant Glass Fiber manufactured by 'N.E.G' or equivalent, Super Plasticizers manufactured by 'ZPXRC' or equivalent, Polymers manufactured by 'Dow Chemicals' or equivalent and U.V resistant Synthetic inorganic pigments should be used for pigmentation. The material casting should take place in FRP Moulds. The GRC flexural strength average L.O.P should be above or equivalent to 6 N/mm² & M.O.R should be above or equivalent to 15 N/mm² for tests done on 28 days cured samples.

The fixing of panels should be 'Dry fixing' i.e. to be done with stainless steel grade 304 L Clamps, anchor fasteners of approved make or self - tapping screws or as per approved shop drawings approved by E-I-C.

Technical Specifications

Plumbing Work

SECTION – I

- 1.1 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Indicative list of items and/or shown on the Plumbing Drawings.
- 1.2 Without restricting to the generality of the foregoing Sanitary installations shall include the following:
 - a) Sanitary Fixtures & CP Fittings including lab fittings etc. as per the GRIHA requirements.
 - b) Drinking water fountain near drinking water point.
 - c) Soil, Waste and Rain Water Pipes.
 - d) Internal and External Water Supply System i/c BMS enabled Flow meter
 - e) Terrace booster pump for lecture blocks (300 & 500 capacity)
 - f) Domestic water distribution system from master plan tapping point to building OHT.
 - g) Recycled water distribution system from from master plan tapping point to building OHT.
 - h) Water meter on the rising main of water supply system for each block.
 - i) Internal and External Sewerage and Storm water drainage system with excavation of pipe around the buildings.
 - j) Neutralization chamber for treatment of Lab waste.

In case of Non DSR Items details of specifications is separately mentioned but wherever specification not provided, Item should be executed as per DSR 2018 & Specification of CPWD (Latest with up to date correction slips).

All Concrete (PCC/RCC etc.) works shall be done with OPC 43 grade cement and for all other works, PPC cement shall be used.

SECTION – II

1. GENERAL INSTRUCTIONS

- 1.1 All works specified in the tender have to be executed in accordance with:
 - a) The latest DSR & guidelines of CPWD specifications as maximum wherever possible.
 - b) The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.
 - c) Applicable norms to be laid down by the relevant sections of latest editions of National Building Code (NBC) and all relevant codes of Bureau of Indian Standards (B.I.S.) shall be followed as applicable.
 - d) The codes of the Uniform Plumbing Code of India and relevant British Standards shall be used as a general guide for good engineering practice, design and workmanship norms.
- 1.2 All materials used in the works shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified hereinafter.
- 1.3 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.
- 1.4 Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior design drawings issued by the Engineer-in-Charge. Work will be executed only as per approved shop drawings.
- 1.5 Contractors shall furnish detailed Shop drawings, hydraulic and other design calculations for approval.
- 1.6 Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.
- 1.7 The work shall be carried out strictly as specified in Indicative list of items, Technical Specifications and drawings.

2. LICENSE AND PERMITS

- 2.1 Contractor must hold a valid Plumbing license issued by the Municipal Authority or other competent authority under whose jurisdiction the work falls.

3. METRIC CONVERSION

- 3.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.
- 3.2 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.

4. **REFERENCE POINTS**

- 4.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.
- 4.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

5. **DRAWINGS ISSUED TO CONTRACTOR**

- 5.1 Service 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
- 5.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.
- 5.3 Contractor shall verify all dimensions at site and bring to the notice of the Architects, all discrepancies or deviations noticed. Architects' decision shall be final.
- 5.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small-scale drawings.
- 5.5 All drawings supplied with the tender shall be returned in good conditions along with the tender.
- 5.6 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings.

6. **SHOP DRAWINGS**

Shop drawings submitted by the contractor have to be approved for their design, functionality and structural stability by IIT Bhilai/ Consultant. So contractor should submit shop drawing well in advance so that work progress doesn't get suffered. The Contractor shall submit to the Engineer in charge Shop Drawings for Plumbing works as an Advance Copy to the Engineer-in-Charge for approval before start of work.

Subsequent to the approval of the shop drawings, the Contractor shall submit Shop Drawings for execution to the Engineer-in-Charge. The Contractor shall also submit four copies of the Technical Specifications and Catalogues for all items.

- 6.1 All Sanitary Engineering drawings issued to the Contractor shall be studied by them. Contractor shall also obtain the necessary architectural, structural and other services drawings, based on which they shall prepare their shop drawings as per site conditions.
- 6.2 Shop drawings shall incorporate the following:
 - All proposed Structural supports/hanging/laying and jointing details for all types of pipes as required.
 - Typical details for Toilets & Fixtures required.
 - Plumbing layout plans as required and for any changes in the layout of Plumbing/ Architectural Drawings.

- Equipment & piping layout for Mechanical and Electrical equipment's as required, SLDs, mounting details of circuit breakers, location of panels, installation of terminals and faucets etc. w.r.t. finishes, surrounding levels & locations.
- Manufacturers and Contractor's fabrication drawings.

6.3 The Contractor can only commence the work after the approval of above documents by Engineer in charge.

6.4 Contractors shall ensure that the Shop drawings are approved by the Engineer-In-Charge in charge prior to any execution.

7. COMPLETION DRAWINGS & DOCUMENTS

7.1 On completion of work contractor shall submit one complete set of original tracings and two prints of "As Built" drawings for the Engineer-In-Charge. These drawings shall have the following information.

- a) Run of all pipes with diameters and length on all floors and vertical stacks.
- b) Ground and Invert levels of all Plumbing services pipes.
- c) Location of all valves.
- d) Location of all Mechanical equipment with layout and piping connection.

7.2 All "Warranty / Guarantee" cards / certificates in original issued by the manufacturers shall be handed over to the Engineer-In-charge also in the form of a comprehensive record book / documents.

8. MATERIALS (SUPPLIED BY THE CONTRACTOR)

8.1 All materials used in the works shall conform to the tender specifications.

8.2 As far as possible all materials shall be bearing I.S. certification marks as per approval of the Engineer-In-Charge.

8.3 All materials shall bear the necessary certification marks, conforming to the Tender Specifications / Drawings requirements.

8.4 Unless otherwise specified and expressly approved in writing by the Engineer-In-Charge, materials of makes and specifications mentioned with tender shall be used.

9. INSPECTION AND TESTING OF MATERIALS

9.1 All materials before being allowed to be brought into the site/store will be preliminary / visually inspected at the entry gate of the project site by contractor quality control team. All materials at site/store room shall be regularly inspected by the Jen/Aen of CPWD as per quality control plan.

9.2 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

9.3 For examination and testing of materials and works at the site Contractor can be asked to provide Testing and Gauging Equipment necessary but not limited to the followings:

-

- a) Theodolite
- b) Dumpy level
- c) Steel tapes

- d) Weighing machine
 - e) Plumb bobs, Spirit levels, Hammers
 - f) Micrometers
 - g) Thermometers, Stoves
 - h) Hydraulic test machine
 - i) Smoke test machine
- 9.4 All such equipment shall be tested for calibration at any approved laboratory, and the test and calibration certificate shall be submitted to the Engineer-In-Charge / Owner.
- 9.5 All Testing Equipment shall be preferably located in special room meant for the purpose.

10. MATERIALS SUPPLIED BY THE OWNER

- 10.1 The Contractor shall verify that all materials supplied by the Owner conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Engineer-In-Charge.
- 10.2 After receipt of materials, it shall be the responsibility of the Contractor for any damage found and he shall be liable to pay the actual cost of the material as per market rate at that time.

11. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS FREE OF COST

If any materials issued to the Contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to the Owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc. or the actual cost given by the Owner shall be final and binding on the Contractor.

12. CONTRACTORS RATES

- 12.1 Rates quoted in this tender shall be inclusive of cost of materials, labor, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, sales tax on works contract and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.
- 12.2 Rates quoted are for all heights and depths required for this work.
- 12.3 All rates quoted must be for complete items inclusive of all such accessories, Fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.
- 12.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete of appropriate mix and strength as directed by Engineer-In-Charge. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.
- 12.5 Rates quoted shall be inclusive of cost incurred in testing, commissioning of works.

13. MOCK UP AND TRIAL ASSEMBLY

The installation of Sanitary Fixtures and fittings shall be as per the shop drawings

approved by Architect / Engineer in charge.

The Contractor shall have to assemble at least one set of each type of Sanitary Fixtures and Fittings in order to determine precisely the required supply and disposal connections. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes, holding devices etc, which will be required for final installation of all Sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Architect / interior designers.

The Fixtures in the trial assembly can be reused for final installation without any additional payments for fixing or dismantling of the fixtures.

14. EXECUTION OF WORK

14.1 The work shall be carried out in conformity with the Plumbing drawings and within the requirements of Architectural, HVAC, Electrical, Structural / Green Building Engineer in charge and other specialized services drawings.

14.2 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 programme.

14.3. On award of the work, Contractor shall submit a programme of construction in the form of a Pert Chart or Bar Chart for approval of the Engineer-In-Charge / Owner. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

14.4 Contractor shall be responsible for co-ordination with other agencies working on the project relating to their scope of work and shall take approval from the Engineer-In-Charge / Owner wherever required.

14.5 Cutting & Making Good

No structural member shall be chased or cut without the written permission of the Engineer-In-Charge.

15. TESTING

15.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

15.2 All Tests shall be performed in the presence of the CPWD Field staff i.e Jen/Aen.

15.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

15.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other by-laws in force.

15.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

15.6 All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested. The Contractor shall block the ends of waste and ventilation pipes and shall conduct air test.

16. SITE CLEARANCE AND CLEANUP

- 16.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.
- 16.2 After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.
- 16.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

17. FINAL INSTALLATION

The Contractor shall install all sanitary fixtures and fittings in their final position in accordance with the approved trial assemblies and as shown on the Drawings. The installation shall be complete 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 true to alignment. The outlet of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting and the receiving pipes before making the joint. 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 necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

18. PROTECTION AGAINST DAMAGE

The Contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation and handling over. At the time of handling over, the Contractor shall clean, disinfect and polish all the fixtures and fittings. Any Fixtures found damped, cracked, clipped, strained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

19. GUARANTEE / WARRANTY

- 19.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.
- 19.2 The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.
- 19.3 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

1. SCOPE OF WORK

- 1.1 The work in general shall be carried out as per CPWD Specifications-2009 Volume-I to II with up to date correction slips.
- 1.2 The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.
- 1.3 The codes of the latest National building code, Uniform Plumbing Code of India and relevant British Standards shall be used as a general guide for good engineering practice, design and workmanship norms.
- 1.4 Work under this section shall consist of furnishing all Material and labour as necessary and required to completely install all Sanitary Fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Indicative list of item.
- 1.5 Without restricting to the generally of the foregoing the Sanitary Fixtures shall include all Sanitary Fixtures, C.P. fittings and Accessories etc. necessary and required for the Building.
- 1.6 Sanitary fixtures and Fitting shall be as per the GRIHA requirements.
- 1.7 Whether specifically mentioned or not all Fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

2. GENERAL REQUIREMENTS

- 2.1 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 Indicative list of item, Specifications and Drawings.
- 2.2 All Fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architectural/ Interior designer's requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.
- 2.3 Fixing screws shall be half round head Chromium Plated brass with C.P. washers wherever required as per directions of Engineer-in-Charge.
 - a) All Fittings and Fixtures shall be fixed in a neat workmanlike manner true to Levels 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 good made and any damage to the finished floor, tiling or terrace shall be made good at Contractors cost.
 - b) When directed, Contractor shall install Fixtures and accessories in a mock-up room for the approval of the Engineer-in-Charge/Owner. Sample room Fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

3.1. **EUROPEAN W.C.**

- 3.1.1 European W.C. shall be wash down, single or double siphonic type, wall mounted set, flushed by means of exposed or concealed type flushing cistern, as specified in Indicative list of item. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair/bolts as per approval.
- 3.1.2 Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.
- 3.1.3 The edge between fixtures and wall shall be sealed with approved type of poly sulphide sealant.

3.2 **INDIAN W.C.**

- 3.2.1 Indian W.C. pan shall be Orissa pattern of size as specified in the Indicative list of item. Each W.C. shall be provided with a 100 mm dia cast iron or porcelain P or S trap with or without vent horn.
- 3.2.2 W.C. shall be flushed by means of an exposed or concealed type cistern or as specified in Indicative list of item.
- 3.2.3 The W.C. shall be fixed in level in a neat workmanlike manner. The W.C. and trap shall be set in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) joints between W.C. and flush pipe shall be made with a putty or other means and linseed oil and caulked well or with an approved rubber joint.

4. **URINALS**

4.1 **URINALS WITH WATER FLUSH**

- 4.1.1 Urinals shall be white glazed Vitreous China flat back half stall or lip type as specified in Indicative list of item.
- 4.1.2 Half stall Urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete and as directed by Engineer-in-Charge/Owner.
- 4.1.3 Half stall urinals shall be fixed with C.P. Brass screws and shall be provided with 32 mm dia Domical Waste leading to Urinal trap.
- 4.1.4 Urinals shall be flushed by means of automatically sensor operated flushing system as specified in Indicative list of item.

4.2 **WATER LESS URINAL**

- 4.2.1 Urinals shall be white glazed Vitreous China flat back half stall type as specified in Indicative list of item.
- 4.2.2 Half stall Urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia C.P. domical waste with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete and as directed by Engineer-in-Charge
- 4.2.3 Half stall urinals shall be fixed with C.P. Brass screws and shall be provided with 32 mm dia Domical Waste leading to Urinal trap.

- 4.2.4 Urinals shall be flushed by liquid as specified in Indicative list of item.

5. **SINKS**

- 5.1 Sinks shall be of precast Terrazzo marble or White Glazed fire clay or vitreous china or stainless steel or any other material as specified in the Indicative list of item.
- 5.2 Each sink shall be provided with R.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Fixing shall be done as directed by Engineer-in-Charge.

6.0 **WASH BASIN**

- 6.1 Wash Basins shall be white glazed vitreous chinaware of size, shape and type as specified in the Indicative list of item.
- 6.2 Each Basin shall be provided with R.S. or C.I. brackets duly painted. The clips and the basin securely fixed to wall and have accessories as mentioned in the Indicative list of item. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and colour as approved by the Architect/Consultants.
- 6.3 Each basin shall be provided with 32 mm dia. C.P. waste of standard pattern with pop-up waste or rubber plug and chain as specified in the detailed engineering, PDR and system requirement, 32 mm dia. C.P. brass bottle trap and angle valve with C.P. pipe to wall and flange as given in the Indicative list of items.
- 6.4 Each basin shall be provided with auto closing pillar cock or as specified in the Indicative list of items.
- 6.5 Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cm or as directed by EIC.

7. **ACCESSORIES**

- 7.1 Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by Engineer-in-Charge and given in the Indicative list of item.
- 7.2 All C.P. Accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with raw plugs or nylon sleeves and shall include cutting and making good as required or directed by Engineer-in-Charge/Owner.
- 7.3 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.

8. **URINAL PARTITIONS**

- 8.1 Urinal partitions shall be of granite as specified in the Indicative list of item and granite.

9. **EWC PAN CONNECTOR**

The EWC pan connector shall be Flexible, soft and shall be made of single body construction with integral fins. The pan connector must be supplied with factory fitted spring loaded seal guard.

While fixing of the pan connector with the Soil pipe, the pipe must be reasonably clean and smooth on the inner surface; in case the soil piping is in C.I. then supplier supplied bush / adaptor shall be used. The connector socket is pushed fully home onto the pan spigot, thereafter the WC is placed in position gently pushing the fitment to ensure that the connector end fits into the Spigot of the pipe. The pan connector must be pushed in such a easy as to ensure that the seals and fins turn inward to ensure proper sealing.

10. Hand Drier:

- 10.1 The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.
- 10.2 The hand drier shall be fully hygienic, rated for continuous repeat use (CRU).
- 10.3 The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds.
- 10.4 The hand drier shall be of wall mounting type suitable for 230V, single phase, 50 Hz, AC power supply.

11. Toilets for Disabled:

- 11.1 Where specified in washroom facilities designed to accommodate physically handicapped, accessories should be provided as directed by the Engineer-in-Charge.
- 11.2.1 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.

SECTION - IV SOIL, WASTE & VENT PIPES

1. SCOPE OF WORK

- 1.1 Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter and given in the Indicative list of item.
- 1.2 Without restricting to the generally of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:
 - a) Vertical and horizontal Soil, Waste and Vent Pipes, Rainwater Pipes and Fittings, Joints supports and clamps and connections to Fixtures.
 - b) Connection of pipes to Gully Traps & Manholes etc.

2. GENERAL REQUIREMENTS

- 2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of 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 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.
- 2.5 All works shall be executed as directed by Engineer-in-Charge.

3. CAST IRON PIPES & FITTINGS (IS: 15905)

3.1 Pipes & Fittings

All pipes & fittings shall be straight and smooth and inside free from irregular bore, blowholes, cracks and other manufacturing defects & shall confirm to the specifications as per IS:15905 for Hubless Cast iron soil, waste & ventilating pipes fittings & accessories, complete in all respects & as specified in the relevant item of the Indicative list of items.

3.2 Other Fittings

- a) Other casted CI Fittings used for drainage pipes shall confirm to the required specifications & as per site conditions & wherever possible to the relevant IS code.

3.3 Fixing

- All vertical pipes shall be fixed by structural support or clamp truly vertical as decided by Engineer in charge. Branch pipes shall be connected to the stack at the same angle as that of the fittings. Each stack shall be terminated at top with a Cowl (terminal guard).

- Horizontal pipes running along ceiling shall be fixed on structural support 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.
- 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 surface.

3.4 **Jointing**

CI pipes shall be jointed with EPDM rubber gasket with SS 304 coupling of approved make only.

4. **PP MATERIALS LOW NOISE LEVEL FOR LAB WATSE PIPES**

The PP Materials based Pipe is a sound-absorbing, hot water resistant pipe system that is suitable for all pressure less sewage pipes according to DIN EN 12056 and DIN 1986-100. The pipes and molded parts are made of PP-M (mineral reinforced Polypropylene), so that general sound protection is guaranteed from the extraction positions to the manifold. PP can be delivered in the DN 50 to DN 200 dimensions with the density of 1.9 gm/cm³. The pipe has long life, and like all plastic materials, it is corrosion-resistant and resistant to aggressive effluents. No crust formation takes place due to the smooth surface. The lesser weight in comparison with metallic pipes and the quick, safe plug in fittings of the system make it easy to lay.

The pipe is resistant to hot water and fulfils the requirements of DIN 1986, which means 95°C short term and 90°C long term temperature loading. The pipe can be used for the drainage of wastewater between pH 2 and pH 12, eg in professional kitchens up to the house connection duct.

5. **UPVC PIPES (I.S. 4985) FOR RAIN WATER**

- 5.1 6 kg/cm² Class selection shall be as per Indicative list of items.

All fittings for uPVC pipes up to 200 mm O.D. size shall be injections moulded as per manufacturer, confirming to IS: 4985 and as specified in Indicative list of items.

- 5.2 For Fittings of sizes which are not injection moulded but fabricated (Locally/ Imported) sample of the same shall be submitted for approval.

6. **CLAMPS / STRUCTURAL SUPPORTS**

- 6.1 G.I. clamps shall be of standard design and fabricated from M.S. flat 40x3mm thick with required Galvanization.

- 6.2 Where G.I. clamps are to be fixed on RCC columns or slotted angles, walls or beam they shall be fixed with 40x3mm flat iron "U" type clamps with anchor fasteners of approved design or 6mm nuts and bolts.

- 6.3 Structural support shall be fabricated from M.S Structural members e.g. rods, angles, channels flats as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black Enamel paint. Wooden saddles, where required shall be provided free of cost.
- 6.4 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 indicative list of items, angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.
- 6.5 Wherever G.I. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size) as directed by the Engineer-in-Charge / Owner.

7. **TRAPS**

- 7.1 Floor traps shall be of CI, deep seal with an effective seal of 50 mm as given in Indicative list of items. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cm of the required depth. Where traps are suspended below ceilings, they shall be provided with proper structural supporting arrangements.

The inside surface of core of trap for bore packing by roughening using suitable file to get better adhesion prior to packing works. Cleaning the surface by wire brushing followed water jet to remove any laitance or loose flaky particles. Providing necessary form work for packing the bore using suitable arrangement (depending upon site conditions). Applying a coat of styrene- butadiene based polymer coating using Nitobond SBR to enhance adhesion between the packing material and other surfaces and Application of swellable Supercast SW20 at the middle of over the pipe external side and. Packing the gap using non-shrink cement polymer based grout using Conbextra GP2 upto the surface of the bore whilst the Nitobond SBR is in tacky state completely for 100 mm dia. pipe as per the manufacturer's Instruction and as per direction of the engineer-in-charge.

7.2 **PP Floor trap**

PP Floor trap has unique feature such as an air tight baffle construction and the incorporation of seals. The trap can be applied directly within the soil & waste system design.

Important aspects in the designing process are: -

- Knockout prevention
- Seals.
- Absorb/correct installation mistakes
- Durability

- Resistant to difficult installation circumstances

7.3 **Urinal Traps**

Urinal traps shall be of CI, deep seal with an effective seal of 50 mm as given in Indicative list of items. and set in cement concrete block specified in Para above without extra charge.

7.4 **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 G.I. inlet hopper without or with one, two or three inlet sockets to receive the waste pipe. Hopper shall be connected to trap with at least 50 mm seal (Hopper and traps shall be paid for separately).

7.3 **Floor drain (Reducing elbow)**

Reducing elbow shall be provided of GI material of 100X50 mm size for carrying of waste into floor trap. Provision for 125 mm grating on top shall be made. It shall be fixed into 100-125 mm sunken area.

7.4 **C.P./Stainless Steel Gratings**

Floor and Urinal Traps shall be provided with 100-150 mm square or round C.P./Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4-5 mm or as specified in the Indicative list of item.

8. **CLEANOUT PLUGS**

Contractor shall provide brass cleanout plugs as required. Cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a male threaded adaptor.

9. **WASTE PIPE FROM APPLIANCES**

9.1 Waste pipe from appliances e.g. wash basins, sinks, urinals, water coolers shall be of G.I. heavy duty as given in the Indicative list of item or as shown on the drawings.

9.2 All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps at approved spacing.

10. **CEMENT CONCRETE**

Soil and Waste pipes under floors 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 20 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 and size at intervals as directed by Engineer-in-Charge/Owner.

11. **CUTTING AND MAKING GOOD**

Pipes shall be fixed and tested as buildings proceeds. Contractor shall provide all necessary holes' cutouts and chases in structural members as building work proceeds. Wherever holes are cut or left originally, 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. Core cutting wherever necessary is to be done by contractor without any extra cost.

12. **Slot Drain near drinking water area**

Bidder has to provide and installed the drain of polymer concrete with slot at the top matching with the tiling plan as per EN standards complete in all respect as per direction of Engineer in charge.

13. **Prefab drain channel**

Prefab-fab polymer concrete channels conforming to relevant EN standards with V-shaped profile, tongue and groove jointing arrangement, in-built ductile iron edge rail, with in-built slope along the complete length of the channel, and polymer concrete channels to be made of zero water absorption, of density being 2.1 - 2.3gm/cm³, with surface roughness of approx 25 µm, with SS grating at the top complete in all respect including all necessary civil and finishing works as required as per site and the instructions of the engineer - in - charge.

14. **INSPECTION & TESTING**

14.1 **Inspection**

Work should be inspected during installation and tests applied on completion, care being taken that, all work which is to be encased for concealed is tested before it is finally enclosed.

Inspection should be carried out to ensure the following:

- a) Work accords with the drawing and specifications.
- b) All pipe brackets, clips etc. are securely fixed.
- c) Fixtures are correctly spaced.
- d) Pipe is protected where necessary by Thermal Insulation.
- e) Embedded pipe work is properly protected before sealing-in
- f) All access covers, caps or plugs.
 - Are accessible
 - Are so made that the internal faces truly complete in internal bore.
 - Cause no obstruction in the pipe bore

- Are well joined.

14.2 **Testing**

The soil, waste piping system and rain water should be tested after installation as follows:

(a) **Water Test**

The pipes shall be tested after installation & before the appliances are connected, preferably in sections so as to limit the static head of 4.5m. The pipe shall be filled with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. Then it will be necessary to seal all openings and leaks at joints immediately as observed during the test and all defective pipes shall be rejected and removed from the site. Pipes with minor sweating shall be accepted at the discretion of the Engineer-in-Charge.

(b) **Smoke Test**

Alternatively, the Contractor may test all Soil, Waste and Rainwater stacks by smoke testing machine. The smoke test shall be carried out as under:

Smoke shall be pumped into the stack after plugging all inlets and connections at the lowest points from a smoke testing machine which consists of a bellow & burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detected by sight as well as by smell, if there is leak at any points of the pipe. The top end shall however be left open. The stack shall then be observed for leakiness and all defective pipes and fittings removed or repaired as directed by the Engineer-in-Charge.

- 14.3 A test register shall be maintained and all entries shall be signed and dated by Contractors and CPWD field staff i.e Jen/Aen.

SECTION – V**WATER SUPPLY SYSTEM****1. SCOPE OF WORK**

- 1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Indicative list of item.
- 1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following: -
 - a) Internal and External water supply system and making connection from external sources for all buildings etc.
 - b) Drinking water supply system
 - c) Pipe protection and painting.
 - d) Control valves, masonry chambers and other appurtenances.
 - e) Connections to all toilets, storage tanks and appliances.
 - f) Excavation and refilling of pipe trenches, wherever required.
 - g) Trenches for taking pipe lines for these services.

2. GENERAL REQUIREMENTS

- 2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-Charge / Owner.
- 2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections. As far as possible all Bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 65mm dia.
- 2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 2.6 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3. G.I. PIPES & FITTINGS

- 3.1 All pipes inside the buildings and where specified, outside the building shall be galvanized steel tubes conforming to I.S. 1239-1979 of class B.
- 3.2 Fittings shall be malleable iron galvanized fittings, of approved make. All fittings shall have manufacturer's trade mark stamped on it. Fittings for G.I. pipes shall include Couplings, Bends, Tees, Reducers, Nipples, Unions, Bushes, Fittings shall be of I.S:1879 - (part I to X) 1975.

- 3.3 The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over. Teflon Tape should be used on threads instead of 'Dhaaga/Safeda'. The end shall then be screwed in the socket, Tee etc. with the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter. 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 shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other as shown on drawings.

4. **CPVC PIPES AND FITTINGS**

4.1 **Description**

CPVC piping shall be Fire Proof, Corrosion resistance with smooth, friction free interior surfaces and with anti - bacterial growth properties.

4.2 **JOINING TUBING & FITTINGS**

(a) **Cutting**

CPVC tubing shall be cut with a wheel-type plastic tubing cutter, a hack saw or other fine toothed hand or power saws. Use of ratchet cutters shall be permitted, provided blades are sharpened regularly. A miter box should be used to ensure a square cut when using a saw.

(b) **Deburring/Beveling**

Burrs and fillings can prevent proper contact between tube and fitting during assembly, and should be removed from the outside and inside of the tubing. A chamfering tool shall be used for this purpose. A slight bevel on the end of the tubing shall be provided to enable entry of the tubing into the fitting socket and minimize the chances of pushing solvent cement to the bottom of the joint.

(c) **Fitting Preparation**

The surfaces shall be wiped clean of dirt and moisture from the fitting sockets and tubing end. Check the dry fit of the tubing and fitting. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

(d) **Solvent Cement Application**

Only approved type Solvent Cement shall have used for jointing the CPVC pipes, which shall be procured as per the manufacturer recommendations. Apply an even coat of Cement Solvent on the Pipe end after cleaning of whole pipe and also inside the fittings socket. Old or deteriorated or thickened or Lumpy Solvent Cement shall not be used.

(e) Assembly

Immediately insert the pipe into fitting socket, rotate the pipe $\frac{1}{4}$ to $\frac{1}{2}$ turn while inserting. This motion ensures an even distribution of cement within the joint. Properly align the fitting. Hold the assembly for approximately 10 seconds, allowing the joint to set-up. An even bead of cement should be evident around the socket edge; it may indicate that sufficient cement was applied. In this case, remake the joint to avoid potential leaks. Wipe excess cement from the tubing and fitting surfaces for an attractive, professional appearance.

5. **STAINLESS STEEL PIPES FOR DRINKING WATER SYSTEM**

The SS pipe for drinking water purposes shall be of grade SS-316 & conforming to EN 10312 standard compete with Press type fittings with SC-Contur in accordance with international regulation (DVGW - W534) & as per approved makes & specifications, complete as per the instructions of Engineer-in-charge & as specified in the Indicative list of items.

6. **CLAMPS**

G.I. pipes in shafts and other locations shall be supported by M.S clamps. Pipe in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural as described in the sub section. Pipes in typical shafts shall be supported on Slotted Angles/Channels as specified elsewhere.

7. **UNIONS**

Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each Valve, Stop Cocks, or Check Valves and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-Charge / Owner.

8. **FLANGES**

Flanged connections shall be provided on pipes where shown on the drawings, all equipment connections as necessary and required or as directed by Engineer-in-Charge / Owner. Connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion rubber washer. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Engineer-in-Charge / Owner. Bolt hole dia for flanges shall conform to match the specification for C.I. Sluice Valve to I.S. 780.

9. **TRENCHES**

The external water supply pipes below ground shall be laid in trenches. The width and depth of the trenches for the different diameters of the pipes shall be as follows:

Dia of Pipe	Width of Trench	Depth of Trench
15mm to 50mm	30 cms	60 cms
65mm to 150mm	45 cms	75 cms

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earthwork in trenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

10. **PAINTING ON EXPOSED WATER SUPPLY PIPES**

- 10.1 All surfaces shall be thoroughly cleaned before painting.
- 10.2 All pipes above ground shall be painted with one coat of primer and two coats of Synthetic Enamel paint of approved shade and quality. Pipes shall be painted to standard color code specified by Engineer-in-Charge/Owner.

11. **PIPE PROTECTION FOR UNDERGROUND WATER SUPPLY PIPES**

Corrosion protection tape shall be wrapped on GI pipes to be buried in ground. This corrosion protection tape shall comprise of coal tar/asphalt component supported on fabric of organic or inorganic fibre and minimum 4 mm. thick and conform to requirement of IS:10221 - code of practice for coating and wrapping of underground line. Before application of corrosion protection tape all foreign matter on pipe shall be removed with the help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky. Both primer and tape shall be furnished by the same manufacturer. Corrosion protection tape shall then be wound around the pipe in spiral fashion and bounded completely to the pipe. There shall be no air pocket or bubble beneath the tape. The overlaps shall be 15 mm and 250 mm shall be left uncoated on either end of pipe to permit installation etc. This area shall be coated insitu after the pipe line is installed. The tape shall be wrapped in accordance with the manufacturer's recommendations. If application is done in cold weather, the surface of the pipe shall be pre-heated until it is warm to touch and traces of moisture are removed and then primer shall be applied and allowed to dry.

12. **BALL VALVES**

The Ball Valve shall be made from forged brass and tested to 16 Kg/cm² pressure. The valve shall be internally threaded to receive pipe connections. The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon. The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm² pressure. The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree.

13. **BUTTERFLY VALVES**

- The Butterfly Valve shall be suitable for waterworks. The Valves conforming to IS : 13095 shall be provided. All valves shall be suitable to withstand the pressure in the system and rating shall be PN 1.6. All valves shall be right handed (i.e. handle or key shall be rotated clock wise to close the valve).
- The direction of opening and closing shall be marked and an open / shut indicator fitted.

- The material of valves shall be as under:-

Body	-	Cast iron
Disc	-	Ductile Iron
Seat	-	EPDM/Nitrile rubber
Shaft	-	Stainless Steel

- The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.
- Joints for butterfly valves shall be made with suitable tail /socket pieces on the pipe line and flanged joints made with 3mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.
- Butterfly valves shall be provided on all branches as shown in the drawings or as specified.

15 Motorized Butterfly valve at the inlet of over head tanks:

Contractor has to install the IP 67 (Weather Proof /Aluminium casing with positioner to indicate the valve position with key type manual overdrive) Motorized Butterfly valve for filling of over head water tank complete with high and low level float type sensors to control the valve. The sensors shall be installed in over head tanks. The sensors will close the valve when water level is high in over head tank and open the valve when over head water tank level is low. The system should be complete in all respects with control panel indicating the position of valve i.e open /closed with accessories like wiring /conduiting /flanges, nut bolts etc complete as per approved type and specifications as per instructions of the engineer - in - charge.

16. Fittings and Inspection Chambers

Fittings and chambers shall be provided as required.

16.1 Anchor Block

Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.

16.2 Rubber Joints

Joints between two pipes shall be made by pre-moulded rubber joints with suitable tackles in a manner recommended & approved by the manufacturer. No joints shall be covered until the lines are hydraulically tested.

17. VALVE CHAMBERS

- 17.1 Contractor shall construct chambers for all full way valves, butterfly valves and other type of valves as specified in the Indicative list of items. These shall be made, in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) on cement concrete foundations 150mm thick 1:5:10 mix (1 cement: 5 coarse sand: 10 graded stone aggregate 40mm nominal size) 12 mm thick cement plaster 1:3(1 cement : 3 coarse sand) inside finished with a floating coat of neat cement with

8mm thick CI surface box with hinged cover and locking arrangement, 150 mm thick reinforcement cement concrete top slab of 1:2:4 (1 cement : 2 coarse sand: 4 graded stone aggregate 20mm nominal size), as specified and shown in drawings, including excavation, back filling rammed and outside rough plaster of 15mm complete or as specified in Indicative list of items.

- 17.2 Valve chambers shall be constructed as specified in indicative list of items but generally shall be of following sizes:

	Length (mm)	Width (mm)	Depth (mm)
For pipes dia. up to 50 mm	300	300	500
For pipes dia. 65 to 80 mm	600	600	1000
For pipes dia. 80 mm and above	750	750	1000

18. TESTING

- 18.1 All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times the working pressure and subject to minimum of 7 kg/cm² in any case and with the consent of Engineer-in-Charge.

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. ($\pm 10\%$). A test register shall be maintained and all entries shall be signed and dated by Contractor and Jen/Aen of CPWD

- 18.2 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and Fixtures shall be made good during the defects liability period without any extra cost.
- 18.3 After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

19. DISINFECTION

- 19.1 After completion of the work Contractor shall flush clean the entire system with the city's filtered water after connection has been made.
- 19.2 After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/l of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable.

20. **PRE COMMISSIONING**

- 20.1 Ensure that all pipes are free from debris and obstructions.
- 20.2 Check all valves for effective opening and closing action. Defects should be rectified or valves replaced.
- 20.3 Ensure that all Connections to Branches have been made.
- 20.4 Ensure that mains have been connected to the respective pumps, underground and overhead tanks.
- 20.5 Water supply should be available at main Underground tank.
- 20.6 All main line Valves should be closed.

21. **COMMISSIONING**

- 21.1 Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.
- 21.2 Start Water Supply Pump and allow water to fill main Underground tank. Water will first fill the fire tank and then overflow to the Raw Water tanks.
- 21.3 After filling Overhead Reservoir drain the same to its one forth capacity through tank scour valve. (This is to ensure removal of all mud, debris etc. from the tank).
- 21.4 Fill Overhead tank to full.
- 21.5 Release water in the main lines by opening Valves in each circuit. Drain out water in the system through scour valves or fire hydrant in lower regions. Ensure clean water is now coming out of the system.
- 21.6 Open valves for individual clusters. Observe for leakages or malfunctions, check pressure & flow at end of line by opening Hydrants etc. Remove and rectify defects noticed.
- 21.7 Check all outlet points for proper operation by opening each valve and allowing water to flow for a few minutes. Also check for effective closure of valve.
- 21.8 The entire water supply system should be disinfected with bleaching powder and system flush cleaned.
- 21.9 Send four samples of water drawn from four extreme locations for testing for bacteriological test in sterilized bottles obtained from the concerned laboratory. (Laboratory personal may collect the samples themselves).

22. **RESPONSIBILITY**

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

SECTION – VI SEWERAGE / DRAINAGE SYSTEM AROUND THE BUILDINGS

1. SCOPE OF WORK

- 1.1 Work under this section shall consist of furnishing all Labour, Materials, Equipments and Appliances necessary and required to completely finish Sewerage/Drainage system as required by the drawings and specified hereinafter or given in the Indicative list of item.
- 1.2 Without restricting to the generality of the foregoing, the sewerage system shall include:
 - Installation of all sewer lines / effluent lines around the buildings.
 - Installation of all storm water drainage lines around the buildings
 - Construction of all catch basins, chambers, manholes & other related civil works etc. around the buildings

2. GENERAL REQUIREMENTS

- 2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Engineer-in-Charge.
- 2.2 Drainage lines shall be laid to the required gradients and profiles.
- 2.3 All drainage work shall be done in accordance with the local Municipal bye laws.
- 2.4 Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the Engineer-in-Charge before the actual execution of work at site.

3. 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 Engineer-in-Charge / Owner from time to time to meet the requirements of the works. Drawings are only indicative in nature, Contractor to submit shop drawing before execution of work.

4. DWC PIPES FOR SEWERAGE LINE

- 4.1 DWC Pipes shall conform IS 16098 (Part-2) and of SN8 class, have a smooth internal surface and corrugated external surface. The corrugated external surface provides greater stiffness, withstands soil movement & takes higher loads (static & dynamic), whereas the internal surface helps in smooth flow of sewerage. DWC Pipes are manufactured using HDPE polymer. These pipes are resistant to various types of gases & chemicals which are generated due to purification of various ingredients flowing in the system.
- 4.2 All the pipes shall be jointed Socket & Spigot joint with elastomeric sealing ring.

5. GULLY TRAPS

- 5.1 Gully traps shall conform to IS 651. These shall be sound, free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from crazing.

They shall give a sharp clear tone when struck with light hammer. There shall be no broken blisters.

6. **REINFORCED CEMENT CONCRETE PIPES FOR STORM WATER SYSTEM**

6.1 All underground storm water drainage pipes where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes of NP-2 class. Pipes shall be true and straight with uniform bore. Throughout cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

6.2 **Laying**

R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings the cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. cradles or concrete bed may be omitted, if directed by the Engineer-in-Charge

6.3 **Jointing**

After setting out the pipes the collars shall be centered over the joint and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools all joints shall be finished at an angle of 45 degree to the longitudinal axis of the pipe on both side of the collars neatly.

7. **TESTING**

All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole. All pipes shall be subjected to a test pressure of at least 1.5-meter head of water. The test pressure shall, however, not exceed 1.5-meter head at any point. The pipes shall be plugged preferably with standard design rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head. The tolerance figure of two liters per centimeter of dia per kilometer may be allowed during a period of ten minutes. Subsidence of the test water may be due to one or more of the following causes:

- Absorption by pipes and joints
- Sweating of pipe or joints
- Leakage at joints or from defective pipes

(a) **Trapped Air**

Allowance shall be made for (i) by adding water until absorption has ceased after which the test proper should commence. Any leakage will be visible and the defective part of the work should be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.

(b) Sewer and Drain Pipelines shall be tested for straightness by:

- Inserting a smooth ball 12mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invent of the pipe and emerge at the lower end.
- Means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.

(c) The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Engineer-in-Charge.

(d) A test register shall be maintained which shall be signed and dated by Contractor and Assistant Engineer.

8. **CEMENT CONCRETE AND MASONRY WORKS FOR MANHOLES AND CHAMBERS ETC**

8.1 **Cement Concrete for Pipe Support**

(a) Wherever specified or shown on the drawings, all pipes shall be supported in concrete bed and haunching as mentioned.

(b) Unless otherwise directed by the Engineer-in-Charge, cement concrete shall be laid as follows:-

Description	Bedding and Haunching
All underground Sewerage pipes around the buildings	All round (1:5:10)
All underground storm water drainage pipes around the buildings	Minimum width of bedding and haunching is D. Thickness of bedding is d/4 or 100mm which ever is higher and haunching is upto D/4 only.(d is internal diameter and D is external diameter of pipe).Grade of concrete is 1:5:10

(c) R.C.C. pipes or C.I. pipes ,may be supported on brick masonry or precast R.C.C or Cast insitu cradles. Cradles shall be as shown on the drawings.

(d) Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks as shown on the drawings.

9. **MANHOLES AND CHAMBERS**

- 9.1 All manholes(other than RCC manholes), chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) or as specified in the Indicative list of item and standard details drawing.
- 9.2 All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix as given in the Indicative list of item or shown on the drawings or as per CPWD specifications

Where not specified, Manholes may be constructed as follows:

(All dimensions internal clear in cms) (As / MMC Regulation)

Size of Manhole Type	90x80 Rect.	120X90 Rect.	91 dia Circular	122 dia Circular	152 dia Circular
Maximum depth	As per CPWD specifications				
Average thickness of R.C.C slab	15	15	--	--	--
Size of cover and frame (Internal dia)	61x45.5	560 dia.	56 dia	56 dia	56 dia
Weight of cover and frame not less than	Heavy duty as specified in the drawings	Heavy duty as specified in the drawings	Heavy duty as specified in the drawings	Heavy duty as specified in the drawings	Heavy duty as specified in the drawings

- 9.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have a slope of 10cm towards the channel. Benching shall be finished with a floating coat of neat cement.
- 9.4 All manholes shall be plastered with 12mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. All brick masonry Manhole shall also be plastered outside with 15mm thick cement mortar.
- 9.5 All manholes with depths greater than 1 M. shall be provided with plastic encapsulated foot rest as specified in indicative drawing vertically and staggered.

10. **NEUTRALIZATION CHAMBER**

These shall be provided on Laboratory Room waste lines before discharging the waste into the main sewer line. It shall be built in RCC masonry and shall be similar in construction to manholes. They shall be constructed to size as shown at the location on drawings and shall be provided with drop inlet, drop outlet, galvanized wrought iron sediment pan and a baffle wall. It shall be provided with 2 Nos., double seal DI Heavy duty manhole cover and frame.

11. **MAKING CONNECTIONS**

Contractor shall connect the new sewer line to the existing manhole by cutting the, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

12. **COMMISSIONING**

12.1 After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary pipings, labours, tools and equipments etc. for carrying out testing and commissioning of the entire external sewerage and drainage system complete as per requirement in the presence of PWD Engineers whenever and as may be required. Generally, the following test/inspection has to be carried out:-

- (a) For any Leakages/seepages in the external sewerage and drainage pipes.
- (b) For checking the functioning of the entire external sewerage and drainage system including rainwater harvesting system and to ensure that the waste water is continuously flowing towards outfall without any intermediate stagnation.
- (c) For the functioning of the valves and accessories etc. by putting ON/OFF the controlling valves of the various diversions in the sewerage and drainage and rain water harvesting system.

8.0 INDICATIVE LIST OF ITEMS FOR INTERNAL PLUMBING SYSTE

Note:- These items are given to facilitate the contractor to complete the work however if some minor items are found missing in the list but is required to complete functioning of the work. Nothing will be paid extra.

S. No.	Indicative List of Items
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SH 8 PLUMBING WORKS

8.1 SANITARY FIXTURES

- 8.1.1 Providing & fixing white vitreous china wall hung type European type water closet with C.P. bolts, nuts, C.I. chair or other hanging arrangement, with white solid plastic seat and cover with lid, dual flush PVC expose cistern (4/2 lpf) with Cistern fittings, C.P. brass hinge rubber buffers, with accessories, C.I./M.S. brackets painted with two coats of enamel paint of approved shade over a coat of primer. C.P. brass screws, wooden cleats including cutting and making good the wall and floors wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.2 Providing and Fixing vitreous china floor mounted (European Type) water closet with 'P' or 'S' trap, C.P. bolts, nuts with solid plastic seat & lid, C.P. brass hinged rubber buffers with (dual flush 4/2 lpf) cistern with flush pipe, clamp and rubber adapter joint C.P. brass screws and washers complete including cutting and making good the walls and floors wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.3 Providing and fixing water closet squatting pan (Indian type W.C. pan) with 100 mm sand cast Iron P or S trap, dual flush (4/2 lpf) white P.V.C. flushing cistern of 6 ltr, 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 etc. complete in all respect as per direction of Engineering-in-charge.
- White Vitreous china Orissa pattern W.C. pan of size 580x440 mm with integral type foot rests
- 8.1.4 Providing and Fixing White vitreous china Under counter wash basin with C.I. brackets painted white, 15 mm CP Brass auto closing pillar cock of flow less than 3 lpm, 32mm dia. C.P. waste, C.P. chain and rubber plug, C.P. connecting pipe to wall and C.P. wall flange and rubber adapter for waste connection complete including cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.

- .1.6 Providing and Fixing vitreous china urinal with electrical/battery operated concealed automatic flushing system flow less than 3.0 lpf CP Brass body with C.I. hangers, 15mm dia inlet to built in spreaders with inbuilt waste with C.P flange for urinal complete including cutting and making good the walls and floors wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.7 Providing and Fixing vitreous china water less urinal with C.I. hangers, 15mm dia inlet to built in spreaders with inbuilt waste with C.P flange, complete including cutting and making good the walls and floors wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.8 Providing and fixing stone slab with table rubbed, edges rounded and polished, of size 75x50 cm deep and 1.8 cm thick, fixed in urinal partitions by cutting a chase of appropriate width with chase cutter and embedding the stone in the chase with epoxy grout or with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6 mm nominal size) as per direction of Engineer-in-charge and finished smooth.
- Granite Stone of approved shade
- 8.1.9 Providing and fixing sink with C.I. brackets, C.P. brass chain with rubber plug, 40 mm C.P. brass waste complete, including painting the fittings and brackets, cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- a) White glazed fire clay sink of size 600x450x 250mm
- 8.1.10 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 :
- 510x1040mm bowl depth 200 mm (Kitchen sink with drain board)
- 8.1.11 Providing and Fixing of wall mounted C.P. brass Sink mixer flow less than 6.0 lpm including cutting and making good the walls wherever required complete in all respects as per direction of the Engineer-in-charge
- 8.1.12 Providing and fixing white vitreous china laboratory sink with C.I. brackets, C.P. brass chain with rubber plug, 40 mm C.P brass waste and 40mm C.P. brass trap with necessary C.P. brass unions complete, including painting of fittings and brackets, cutting and making good the wall wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- Size 600x450x200 mm

- 8.1.13 Providing & fixing CP brass elbow action bib cock for lab sink flow less than 6.0 lpm including cutting & making good the walls wherever required complete in all respects as per Engineer-in-charge.
- 8.1.14 Providing and Fixing 15 mm nominal bore CP Brass long body bib cock flow less than 6.0 lpm of approved quality conforming to IS Standards etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.15 Providing and Fixing C.P. brass towel ring "Round" fixed to PVC cleats with C.P. brass screws including cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.16 Providing and fixing SS liquid soap dispenser with push lever assembly with soap refill fixed in wall with Screws complete in all respect as per direction of the engineer-in-charge
- 8.1.17 Providing and fixing S.S. body tissue paper dispenser complete including cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.18 Providing and fixing CP Brass Bottle Trap of approved quality & make etc. complete in all respect as per direction of Engineering-in-charge.
- a) 32 mm dia
 - b) 40 mm dia
- 8.1.19 Providing and fixing C.P. brass angle valve of approved quality conforming to IS:8931 etc. complete in all respect as per direction of Engineering-in-charge. 15mm nominal bore
- 8.1.20 Providing and Fixing C.P. Brass Toilet paper holder, including cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.21 Providing and fixing Health faucet with 1 metre long Flexible Tube and CP wall hook with PVC & SS Screws flow less than 6 lpm wherever required complete as directed by the Engineer-in-charge

- 8.1.22 Providing and Fixing two way bib cock flow less than 6.0 lpm complete, including cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.23 Providing and Fixing Handicapped set including white vitreous china floor mounted European type water closet including dual flush exposed cistern (4/2 lpf) , Flat Back wash basin with one pair of mounting brackets , complete with fittings, seat cover, two no hinged rail 76 cms and five nos of grab bar 60 cms including 15 mm dia autoclosing pillar cock flow less than 3.0 lpm for Handicaped Toilet complete in all respect as per direction of the engineer-in-charge.
- 8.1.24 Providing and fixing C.P cast brass Double coat hook as approved with C.P. brass screws complete as per instructions of the engineer-in-charge.
- 8.1.25 Providing and Fixing C.P brass Aerosol perfume dispenser, fixed to wooden cleats / Rawl Plug with C.P brass screws, complete wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.26 Providing & fixing CP emergency shower with pull chain connected to water supply pipes including cutting & making good the walls complete in all respects required as per Engineer-in-charge.
- 8.1.27 Providing & Fixing CP self closing eye wash fountain with CP waste, CP chain & rubber plug, CP cast brass bottle trap & CP connecting pipe to wall and CP wall flange & rubber adopter for waste connection complete in all respects including cutting & making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.28 Providing and Fixing straight / offset type flexible single body push fit type WC pan connector with factory supplied seal guard with integral Single mould sealing fins made of flexible EVA body, including bush / adaptor for use with C.I. Pipe as supplied with the pan connector etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.29 Providing and fixing Stainless Steel Body Auto hand drier to be operated with 220 volts, single phase, with fully hygienic condition, with all accessories including cutting and making good the walls, wherever required etc. complete in all respect as per direction of Engineering-in-charge.
- 8.1.30 Providing and Fixing in position storage type Hot Water electrical vertical heaters with copper container, insulation, and stove enameled M.S. jacket, thermostatically controlled immersion heater, with pilot lamp, 15/20mm dia inlet with non return valve and 15/20mm dia outlet including making connections complete in all respects. (wall mounted with suitable M.S. bolts and nuts)

a) 25 Ltr

8.2 SOIL, WASTE AND VENT PIPES

8.2.1 Providing and fixing soil, waste and vent pipes :

100 mm dia

Hubless centrifugally cast (spun) iron pipes epoxy coated inside & outside IS:15905

8.2.2 Providing and Fixing M.S. Holder bat clamp (factory manufactured) of approved design to sand cast iron / cast iron (spun) pipes comprising of M.S. flat brackets made of 50x5 mm flat of specified shape, projecting 75 mm outside the wall surface and fixed on wall with 4 Nos, 6 mm diameter expansion hold fasteners including drilling necessary holes in brick wall /CC/RCC surface and the cost of bolts etc. . The pipes shall be fixed to the already fixed brackets with the help of 30 mmx1.60 mm galvanized M.S. flats of specified shape and total length 420 mm and shall be fixed with M.S. nuts, bolts and washers of size 25x6 mm, one bolt on each side of the pipe.

Total bracket length 580 mm of approved shape and design, (for single 100 mm dia pipe)

Total bracket length 810 mm of approved shape and design, (for single 100 mm dia pipe)

8.2.3 Providing and fixing bend of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete.

100 mm dia

Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905

8.2.4 Providing and fixing plain bend of required degree.

100 mm dia

Hubless centrifugally cast (spun) iron pipes epoxy coated inside & outside IS:15905

8.2.5 Providing and fixing single equal plain junction of required degree :

100x100x100 mm

Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905

8.2.6 Providing and fixing double equal plain junction of required degree.

100x100x100x100 mm

Hubless centrifugally cast (spun) iron pipes epoxy coated inside & outside IS:15905

- 8.2.7 Providing and fixing door piece, insertion rubber washer 3mm thick, bolts & nuts complete :
100 mm
Sand cast iron S&S as per IS – 3989
- 8.2.8 Providing and Fixing 100 mm dia Terminal guard for Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905
100 mm
Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905
- 8.2.9 Providing and fixing shielded coupling for Hubless centrifugally cast iron pipe
100 mm dia
SS 304 grade coupling with EPDM rubber gasket
- 8.2.10 Providing and fixing M.S. stays and clamps for sand cast iron hubless pipes of diameter:
100mm
- 8.2.11 Providing and fixing trap of self cleansing design with screwed down or hinged grating with or without vent arm complete, including cost of cutting and making good the walls and floors :
100 mm inlet and 100 mm outlet
Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905
- 8.2.12 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.
- 8.2.13 Providing and Fixing G.I. Reducing elbow (Floor drain) of 100 x 50 mm in cement concrete 1:2:4 at all levels for floor drains for connection to floor traps in sunken portions, complete as per drawings and as per approval of the engineer-in-charge.

- 8.2.14 Providing, fixing, testing & Commissioning of PP materials filled low noise level soil, waste and vent pipe with density 1.9 g/cm³ conforming to DIN EN 12056 along with all required fittings like tees, bends, cowls, crosses with or without access doors jointed with approved push fit rubber ring socket joint / solvent cement fixed to walls and ceilings, cutting holes in brickwall wherever required, filling the annular space between pipe & wall/slab/beam with hand mixed concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and making good the floors, beams and walls with cement mortar where required complete of outer diameter.**(For LABS)**
- a) 50 MM OD
 - b) 75 MM OD
 - c) 110 mm OD
- 8.2.15 Providing and fixing on wall face unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion.(i) Single socketed pipes.
- a)75 MM Diameter
 - b)110 MM Diameter
- 8.2.16 Providing and fixing 100 mm diameter and 60 cm long rain water spout in cement mortar 1:4 (1 cement : 4 fine sand).
- a)uPVC spout Type A
- 8.2.17 Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion.
- a)Single Push fit coupler
 - 75 mm dia
 - 110 mm dia
 - b)Single Tee with door
 - 75x75x75 mm dia
 - 110x110x110 mm dia
 - c) Bend 87.5 Deg
 - 75 mm dia
 - 110 mm dia

d) Shoe (Plain)

75 mm dia

110 mm dia

8.2.18 Providing and Fixing of G.I. coated holder bat clamp of approved design to uPVC pipes comprising of G.I. coated holder flat brackets made of 50X5 mm flat of specified shape, projecting 75 mm outside the wall surface and fixed on wall with 2 nos. 6 mm dia. expansion hold fasteners, including drilling necessary holes in brick wall/CC/RCC surface and cost of bolts etc. The pipes shall be fixed to the already fixed brackets with the help of 6 mm dia. galvanised bar of specified shape and of total length 400 mm and shall be fixed with G.I. coated nuts, bolts & washers one bolt on each side of the pipe etc complete in all respect as per direction of Engineering-in-charge. (Rain water pipes)

a) 75 mm dia

b) 110 mm dia

8.2.19 Providing and Fixing to the inlet mouth of rain water pipe SS 304 grating of following diameter complete in all respects as per direction of the engineer-in-charge

a) For 75 mm dia

b) For 100 mm dia

c) For 150 mm dia

8.2.20 Providing and Fixing G.I. "B" class pipe complete with G.I. Fittings and clamps, including cutting and making good the walls etc. (Internal work)

a) 32 mm dia

b) 40 mm dia

c) 50 mm dia

8.2.21 Painting of G.I. Pipes and fittings with two coats of anti-corrosive bitumastic paint of approved quality.

a) 32 mm dia

b) 40 mm dia

c) 50 mm dia

8.2.22 Providing and fixing G.I. Inlet fittings with maximum 3 inlets 32, 40 & 50 mm size fabricated from 100 mm dia G.I. pipes and welded G.I. sockets, fixed to C.I. Trap with joints and set in cement concrete (1:2:4) complete as directed by Engineer-in-charge.

- 8.2.23 Providing and Fixing SS 304 Grating with frame and SS Screws casted heavy 125 mm dia complete as directed by Engineer-in-charge.
- 8.2.24 Providing and fixing cast brass cleanout plug / floor cleanout with suitable insert keys for opening, male threaded joint with G.I. socket caulked to spun soil pipe including cost of joint etc. complete as directed by Engineer-in-charge.
- a) 100 mm dia
 - b) 150 mm dia
- 8.2.25 Providing and fixing 160 mm dia UPVC rain water pipes of 6 kg./cm² 'Type A' conforming to IS: 4985 including all fittings with or without access door or without access i.e bends, junctions, cowls, offsets, etc., and jointing with solvent cement and excavation, refilling and disposal of surplus earth, including cutting holes in walls and floors, excavation, refilling and disposal of surplus earth wherever required and making good the same, complete as directed by the Engineer-in-Charge.
- 8.2.26 Making core cutting holes for C.I. Pipe of 100 mm dia. etc. in R.C.C. floors and roofs for passing C.I. pipe etc. and repairing the hole after insertion of C.I. pipe etc. with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), including finishing complete so as to make it leak proof.
- 8.2.27 Providing and fixing 6 mm dia. G.I. level adjusting hangers (upto 1200mm length), fixed to roof slabs by means of ceiling cleats made out of G.I. flat 40x3mm size 60 mm long and stainless steel expandable dash fastener of 12.5 mm dia and 50 mm long, complete as per direction of Engineer-in-charge.
- 8.2.28 Preparing the inside surface of core for bore packing by roughening using suitable file to get better adhesion prior to packing works. Cleaning the surface by wire brushing followed water jet to remove any laitance or loose flaky particles. Providing necessary form work for packing the bore using suitable arrangement (depending upon site conditions). Applying a coat of styrene-butadiene based polymer coating using Nitobond SBR to enhance adhesion between the packing material and other surfaces and Application of swellable Supercast SW20 at the middle of over the pipe external side and. Packing the gap using non-shrink cement polymer based grout using Conbextra GP2 upto the surface of the bore whilst the Nitobond SBR is in tacky state completely **for 100 mm dia. pipe** as per the manufacturer's Instruction and as per direction of the engineer-in-charge.

- 8.2.29 Providing and fixing pre-fab polymer concrete channels conforming to relevant EN standards with V-shaped profile, tongue and groove jointing arrangement, in-built ductile iron edge rail, with in-built slope along the complete length of the channel, and polymer concrete channels to be made of zero water absorption, of density being 2.1 - 2.3gm/cm³, with surface roughness of approx 25 µm, with SS grating at the top complete in all respect including all necessary civil and finishing works as required as per site and the instructions of the engineer - in - charge, for following sizes: Size 250 x 385 mm (B x H)
- 8.2.30 Supply and installation of Slot Drain K-100 Brickslot polymer concrete channels having Length of 1000 mm, Width of 130 and depth as per site requirement confirming to Euro Norms DIN EN 1433 of , V-shaped profile, tongue and groove jointing arrangement, inbuilt galvanized iron edge rail and a approx weight of 16 kg/unit. These channels have Stainless Steel Slot and confirming to Load Class A15 as per EN DIN 1433. Inspection Unit of 500 mm length ,130mm width and depth as per site requirement is also provided with the unit .

8.3 WATER SUPPLY (INTERNAL AND EXTERNAL AROUND THE BUILDING)

- 8.3.1 Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m : All Kinds of Soil Pipes, cables etc, not exceeding 80 mm dia.
- 8.3.2 Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m : All Kinds of Soil Pipes, cables etc. exceeding 80 mm dia. but not exceeding 300 mm dia
- 8.3.3 Providing and fixing G.I. pipes complete with G.I. fittings and clamps, i/c cutting and making good the walls etc. Internal work - exposed on wall
- a) 20 mm nominal bore
 - b) 25 mm nominal bore
 - c) 32mm nominal bore
 - d) 40 mm nominal bore
 - e) 50 mm nominal bore
 - f) 65 mm nominal bore
 - g) 80 mm nominal bore
- 8.3.4 Providing and fixing G.I. pipes complete with G.I. fittings including trenching and refilling etc. External works
- a) 25 mm nominal bore
 - b) 32 mm nominal bore
 - c) 40 mm nominal bore
 - d) 50 mm nominal bore
 - e) 65mm nominal bore
 - f) 80mm nominal bore
 - g) 100 mm nominal bore
 - h) 150 mm nominal bore

- 8.3.5 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 wall etc.

- a) 15 mm nominal outer dia pipes
- b) 20 mm nominal outer dia pipes
- c) 25 mm nominal outer dia pipes
- d) 32 mm nominal outer dia pipes
- e) 40 mm nominal outer dia pipes
- f) 50 mm nominal outer dia pipes

- 8.3.6 Providing and fixing Stainless Steel 316 L pipes confirming to EN 10312 complete with Press Type fittings with SC-Contur in accordance with DVGW regulation W534 such as sockets, bends, elbows, tees, reducers, unions, Flanges, clamps/structural steel supports, hangers etc. necessary adapters SS to CP fittings, jointing, sundries, cutting holes in walls/floors/slabs & making good including wrapping with polythene sheet tape etc. **(For drinking water purposes):**

- a) 15 mm OD
- b) 22 mm OD
- c) 28 mm OD
- d) 35 mm OD
- e) 42 mm OD

- 8.3.7 Providing and fixing G.I. Union in G.I. pipe including cutting and threading the pipe and making long screws etc. complete (New work) :

- a) 20 mm dia
- b) 25 mm dia
- c) 32 mm dia
- d) 40 mm dia
- e) 50 mm dia
- f) 65 mm dia
- g) 80 mm dia

- 8.3.8 Painting G.I. pipes and fittings with synthetic enamel white paint with two coats over a ready mixed priming coat, both of approved quality for new work :
- a) 20 mm dia
 - b) 25 mm dia
 - c) 32 mm dia
 - d) 40 mm dia
 - e) 50 mm dia
 - f) 65 mm dia
 - g) 80 mm dia
- 8.3.9 Providing and filling sand of grading zone v or coarser grade all-round the G.I. Pipe in external work
- a) 25 mm dia pipe
 - b) 32 mm dia pipe
 - c) 40 mm dia pipe
 - d) 50 mm dia pipe
 - e) 65 mm dia pipe
 - f) 80 mm dia pipe
 - g) 100 mm dia pipe
 - h) 150 mm dia pipe
- 8.3.10 Providing and Laying anti corrosive tape, 100 mm wide and 4 mm thick including an initial coat of primer for preventing the corrosion of buried pipes in trenches, complete in all respects as per the direction of engineer-in-charge.
- a) 25 mm dia pipe
 - b) 32 mm dia pipe
 - c) 40 mm dia pipe
 - d) 50 mm dia pipe
- 8.3.11 Providing and fixing forged brass lever operated ball valve of full flow with forged brass ball (Machined to mirror smooth finsh with hard chrome plated) and spindle with setting and

gland of superior quality having minimum working pressure of 16 kg/cm² etc. complete in all respect.

- a) 20 mm dia
- b) 25 mm dia
- c) 32 mm dia
- d) 40 mm dia
- e) 50 mm dia

8.3.12 Providing and fixing C.I butterfly valve, wafer end type class PN 1.6 as per I.S:13095 or BS:5155, including necessary nuts, bolts, gaskets etc., complete

- a) 65 mm dia
- b) 80 mm dia
- c) 100 mm dia
- d) 150 mm dia

8.3.13 Constructing masonry chamber 30x30x50 cm with cement based fly ash bricks, inside with brick work in cement mortar 1:4 (1 cement : 4 Coarse sand) for stop cock, with C.I. surface box 100x100x75 mm (inside) with hinged cover fixed in cement concrete slab 1:2:4 mix (1 cement: 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) necessary excavation foundation concrete 1:5:10 mix (1 cement : 5 fine sand and 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.
With cement based fly ash bricks of 1st class. Extra depth to be provided as per site condition if required

8.3.14 Constructing masonry Chamber 60x60x75 cm inside, in brick work in cement mortar 1:4 (1 cement : 4 coarse sand) for sluice valve, with C.I. surface box 100mm. top diameter, 160 mm bottom diameter and 180 mm deep (inside) with chained lid and RCC top slab 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm 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 :
With cement based fly ash bricks of 1st class. Extra depth to be provided as per site condition if required.

8.3.15 Constructing brick masonry chamber for underground C.I. inspection chamber and bends with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover with frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg), R.C.C. top slab with 1:1.5:3 mix (1 cement : 1.5 Fine sand : 3 graded stone aggregate 20 mm nominal size), foundation concrete 1:5:10

(1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand), finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design:

Inside dimensions 500x700 mm and 45 cm deep for pipe line with one or two inlets :

With cement based fly ash bricks of 1st class

8.3.16 Extra for depth beyond 45 cm of brick masonry chamber :

For 500x700 mm size

With cement based fly ash bricks of 1st class

8.3.17 Providing and placing on terrace (at all floor levels) polyethylene water storage tank, IS : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.

8.3.18 Providing and Fixing of double flanged Water Flow Electromagnetic type Meter complete with digital display provision & including Pulse generator and Remote Totalizer complete in all respect as per the technical specifications.

- a) 25 mm dia
- b) 32 mm dia
- c) 40 mm dia
- d) 50 mm dia

8.3.19 Providing and Fixing Pressure Reducing station for cold water supply comprising of 2 Nos. of brass ball valves on outlet and bye-pass and ball valve with inbuilt strainers and a PRV (Diaphragm type) unit with out going pressure gauge with flanged or union connection including safety valve. The complete system is tested to a pressure not less than 15 Kg/Cm² and suitable to reduce the pressure from 3.5 Kg/Cm² to 1.0 Kg/Cm²(or as desired at site) including flanges/unions, nuts, bolts and washers complete as required for applications. (Horizontal or vertical as applicable).

- a) 25 mm dia
- b) 32 mm dia
- c) 40 mm dia
- d) 50 mm dia

8.3.20 Providing & fixing M.S. structural work fabricated from standard section e.g. M.S rounds, angles, channels, plates including cutting to size, drilling, welding fixing and

welding to insert plates in RCC structural members as directed by engineer-in-charge including cutting and making good the walls, ceilings and floors.

8.4 SEWERAGE AND DRAINAGE SYSTEM AROUND THE BUILDINGS

- 8.4.1 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 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 50 m. All Kinds of Soil/Ordinary rock Pipes, cables etc., exceeding 80mm dia but not exceeding 300mm dia
- 8.4.2 Extra for excavating trenches for pipes, cables, etc. in All Kinds soil/ordinary rock exceeding 1.5 m in depth but not exceeding 3 m. All Kinds of Soil/Ordinary rock Pipes, cables etc., exceeding 80mm dia but not exceeding 300mm dia
- 8.4.3 Providing and laying non-pressure NP2 class 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.
- a) 150 mm Dia
 - b) 200 mm Dia
 - c) 250 mm dia
 - d) 300 mm dia
- 8.4.4 Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) all-round the pipes of different dia for sewerline including bed concrete as per standard design.
- a) 150 mm dia.
 - b) 200 mm dia.
- 8.4.5 Providing and Laying Double wall corrugated (SN-8 class) Black pipes conforming to IS: 16098 Part -2, for Sewerage system with all required fittings including jointing by click ring & sealing ring/ solvent cement joint including testing of joints, setting right the leaking of joints etc. complete as per instructions of the Engineer-In-Charge.
- a) 150 mm dia..
 - b) 200 mm dia.

- 8.4.6 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 ::
150 x 100 mm size P type With cement based fly ash bricks of 1st class
- 8.4.7 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 ::
180 x 150 mm size P type With cement based fly ash bricks of 1st class
- 8.4.8 Constructing brick masonry manhole in cement mortar 1:4 (1 cement : 4 coarse sand) with RCC Top slab with 1:2:4 mix (1 cement : 2 coarse sand: 4 graded stone aggregate 20mm nominal size) foundation concrete 1:4:8 mix (1 cement :4 coarse sand: 8 graded stone aggregate 40 nominal size), inside plastering 12mm thick with cement mortar 1:3 (1 cement : 3 coarse sand), finished with a floating coat of neat cement and making channels in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement complete as per standard design . Inside size 90x80 cm and 45 cm deep including C.I. cover with frame (Heavy duty) 455x610 mm internal dimensions, total weight of cover and frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg) .(Excavation of manhole and 12mm thick cement plaster at the external surface is included) With cement based fly ash bricks of 1st class
- 8.4.9 Constructing brick masonry manhole in cement mortar 1:4 (1 cement : 4 coarse sand) with RCC Top slab with 1:2:4 mix (1 cement : 2 coarse sand: 4 graded stone aggregate 20mm nominal size) foundation concrete 1:4:8 mix (1 cement :4 coarse sand: 8 graded stone aggregate 40 nominal size), inside plastering 12mm thick with cement mortar 1:3 (1 cement : 3 coarse sand), finished with a floating coat of neat cement and making channels in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement complete as per standard design . 'Inside size 120x90 cm and 90 cm deep including C.I. cover with frame (heavy duty) 560 mm internal diameter, total weight of cover and frame to be not less than 116 kg (weight of cover 58 kg and weight of frame 58 kg) .

(Excavation of manhole and 12mm thick cement plaster at the external surface is included)
With cement based fly ash bricks of 1st class
- 8.4.10 Extra depth of manholes Size 90x80cms With cement based fly ash Bricks with class designation 75
- 8.4.11 Extra depth of manholes Size 120x90cms With cement based fly ash Bricks with class designation 75

- 8.4.12 Constructing Brick Masonry circular type manhole 0.91 m internal dia at bottom and 0.56m dia at top in cement mortar 1:4 (1 cement : 4 Coarse sand), inside cement plaster 12mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement, foundation concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 40mm nominal size) 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. External surface shall be finished with 15mm thick cement plaster 1:6 (1 cement : 6 Coarse sand) as per side conditions. 0.91 m deep with SFRC cover and frame (heavy duty, HD- 20 grade designation) 560 mm 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 12mm thick cement plaster at the external surface is included) : With cement based fly ash bricks of 1st class
- 8.4.13 Extra depth for circular type Manhole 0.91 internal dia with cement based fly ash Bricks class designation 75, depth beyond 0.91 m to 1.67 m
- 8.4.14 Constructing Brick Masonry circular manhole 1.22 m internal dia at bottom and 0.56m dia at top in cement mortar 1:4 (1 cement : 4 Coarse sand), cement plaster 12mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement, foundation concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 40 mm nominal size) 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. External surface shall be finished with 15mm thick cement plaster 1:6 (1 cement: 6 Coarse sand) as per side conditions. 1.68 m deep with SFRC Cover and frame (heavy duty HD- 20 grade designation) 560 mm 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 is included in item) With cement based fly ash bricks of 1st class
- 8.4.15 Extra depth for Circular type Manhole 1.22 m internal dia (at Bottom) With cement based fly ash bricks class designation 75, Depth beyond 1.68 to 2.29 m.
- 8.4.16 Constructing Brick Masonry circular manhole 1.52 m internal dia at bottom and 0.56m dia at top in cement mortar 1:4 (1 cement : 4 Coarse sand), inside cement plaster 12mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement, foundation concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 40 mm nominal size) 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 .External surface shall be finished with 15mm thick cement plaster 1:6 (1 cement : 6 Coarse sand) as per side conditions. 2.30 m deep with SFRC Cover and frame (heavy duty HD-20 grade designation) 560 mm 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 is included in

item)

With cement based fly ash bricks of 1st class

- 8.4.17 Extra depth for circular type manhole 1.52 m internal dia (at bottom) beyond 2.30 m :
With cement based fly ash bricks of 1st class
- 8.4.18 Providing & fixing orange colour safety foot rest of minimum 6mm thick plastic encapsulated as per I.S:10910 on 12 mm dia steel bar conforming to I.S:1786 having minimum cross section as 23mm x 25mm and over all minimum length 263mm and width as 165mm with minimum 165 mm space between protruded legs having 2mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufacturer's permanent identification mark to be visible even after fixing, including fixing in manholes with 30x20x15cm cement concrete block 1:3:6 (1 cement: 3 coarse sand: 6 graded stone aggregate 20mm nominal size) complete as per design.
- 8.4.19 Constructing brick masonry road gully chamber 45x45x77.5 cm with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) with precast R.C.C. vertical grating complete as per standard design, .(Excavation of manhole and 12mm thick cement plaster at the external surface is included)
With cement based fly ash bricks of 1st class.
- 8.4.20 Extra depth of rgc up to 100 cm
- 8.4.21 Constructing brick 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, .(Excavation of manhole and 12mm thick cement plaster at the external surface is included)With cement based fly ash bricks of 1st class.
- 8.4.22 Extra depth of RGC up to 100 cm.
- 8.4.23 Constructing brick masonry road gully chamber 110x50x77.5 cm with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) including 500x450 mm precast R.C.C. horizontal grating with frame and vertical grating complete as per standard design,(Excavation of manhole and 12mm thick cement plaster at the external surface is included.) With cement based fly ash bricks of 1st class.
- 8.4.24 Extra depth of RGC up to 120 cm
- 8.4.25 Construction of Grease trap of size 2 m x 1 m (Internal) with effective depth as required on site with Brick Masonry in Cement 1:4 (1 Cement: 4 Coarse sand) over a bed of 150 mm thick PCC 1:5:10 (1 Cement: 5 Coarse sand: 10 graded stone aggregate 40 mm nominal size)

including a baffle wall of Brick work, covered with RCC slab of 150 mm thickness, of 1:2:4 mix (1 Cement: 2 Coarse sand: 4 graded stone aggregate of 20 mm nominal size) including centering, shuttering and reinforcement complete with providing and fixing Foot rests @300 mm C to C with Two 600x600 mm D.I. Manhole Covers with Lifting arrangement, including 150 mm dia Inlet & Outlet pipes complete . (Excavation of manhole and 12mm thick cement plaster at the external surface is included.)

- 8.4.26 Construction of Neutralization chamber of size 2000 mm x1000 mm (Internal) with effective depth as required on site with Brick Masonry in Cement 1:4 (1 Cement: 4 Coarse sand) over a bed of 150 mm thick PCC 1:4:8 (1 Cement: 4 Coarse sand: 8 graded stone aggregate 40 mm nominal size) including , covered with RCC slab of 150 mm thickness, of 1:2:4 mix (1 Cement: 2 Coarse sand: 4 graded stone aggregate of 20 mm nominal size) including centering, shuttering and reinforcement complete with providing and fixing Foot rests @300 mm C to C with two 610x455 mm DI Heavy duty Manhole Covers with Lifting arrangement, including 150 mm dia Inlet & Outlet pipes complete etc. in all respect as per direction of Engineering-in-charge. ,(Excavation of manhole and 12mm thick cement plaster at the external surface is included.)

Providing and laying cement concrete 1:5:10 (1 cement: 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) up to haunches for drainage pipes as per standard design as shown in drawing/specification to drainage pipes of different diameter including bed concrete.

- 8.4.27
a) 150 mm

8.5 MISCELLANEOUS

- 8.5.1 Providing and fixing 750 mm long hot dipped G.I. Puddle flanges for water tanks as per I.S. 1239 (Class C) with 6mm thick M.S. Plate of suitable size and welded around the pipe fixed in walls, beams and top slab of R.C.C tanks, complete with all details in all respects and as per drawing. (For over head tanks & underground)

- a) 25 mm dia
- b) 32 mm dia
- c) 40 mm dia
- d) 50 mm dia
- e) 65 mm dia
- f) 80 mm dia
- g) 100 mm dia
- h) 150 mm dia

- 8.5.2 Providing and fixing 80 mm dia insect-proof coupling to vent pipes of overhead tank with threaded or flanged joints, including M.S. flanges, nuts, bolts, 3mm thick rubber insertions complete.

- 8.5.3 Providing and fixing of wall hanging **drinking water fountain**, made by stainless steel top and heavy duty galvanized steel frame. ADA Compliant, size 472 mm Depth X 447mm width, flexible bubbler guard , operated between 50 to 120 PSI, Complete with all accessories which include MD-CU29, which is an EPA registered antimicrobial copper that fights off microorganisms which include MRSA and e-coli on push pad. The water Fountain shall certified by NSF-USA, Green building, TUN, UL, to be placed at different location of buidling. installing the Water Fountain for proper functioning and aesthetic view as directed by the engineer-in-charge without any extra cost.

TECHNICAL SPECIFICATIONS ELECTRICAL WORKS

General Scope of Work.

- 33/.433 KV incoming & VCB Panel
- 33KV/ 433V oil Type Transformer
- DG Sets
- Medium /Low Voltage Panels
- Bus Duct (Sandwich type)/ Rising Mains
- APFC Panel
- Earthing System
- Energy meter for HT/ LT Panels
- Fire Survival Cable
- Light Fixture & Fans
- Lift work.

GENERAL SCOPE OF WORK: ALL ELECTRICAL WORKS IS TO BE CARRIED OUT AS PER DRAWINGS AND TECHNICAL SPECIFICATION.

ITEM GIVEN IN THE DRAWINGS AND SPECIFICATION ARE TENTATIVE AND IF ANY ITEMS ARE MISSED BUT REQUIRED FOR FUNCTIONALLTY IS TO BE EXECUTED BY AGENCY WITHOUT ANY EXTRA PAYMENT.

1. All internal electrical works shall be carried out with PVC (Concealed)/MS Heavy Grade (Surface) conduit. All switches, sockets, AC ON & OFF 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. Power point for computer shall have 2 sockets and 2 switches in one box.
2. All mounting boxes for plate type accessories shall be of G.I. and of the same make as that of the plate type switches and accessories.
3. The wires used for the point wiring and power wiring shall be of 1100 Volts grade HFFR (flame Retardant low Smoke) Insulated multi stranded copper conductor single core cables.
4. All lighting fixtures should be LED type (CAT AAA) having efficacy more than 130 Lumen / Watt and CRI >80, THD <5%, LM 79 & LM 80 test report from NABL accredited lab should be submitted by the agency. Color temperature may be 3000/4000/6000K as per site requirement. The external light fixtures shall be IK 10, IP 65 rating fitting.
5. Lighting Design should be carried out as per National Lighting Code 2010/NBC/ECBC guidelines. Wherever range of illumination for space is mentioned, higher side of Lux level must be taken for design purpose.
6. Ceiling fans shall be provided everywhere except stairs/toilets / Bathrooms. Only BLDC type ceiling fans of size 1400 / 1200 / 900 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 – 2013 and NBC 2016.
7. Wiring & Conducting for Telephone system shall be terminated in suitable size of G.I. box and terminated in Modular Telephone outlet Socket at one end and Crone Type Telephone Tag box at another end. The wiring shall be suitably tagged/mentioned the location of each point.
8. Wiring & Conducting for TV system shall be connected to suitable size of G.I. box in Modular TV outlet Socket at one end and Dish TV box at another end. The wiring shall be suitably tagged/mentioned the location of each point.
9. Wiring & Conducting with Modular type G.I. Boxes shall be provided for Data, WIFI, IP based CCTV, Access Control System.
11. Minimum size of copper conductor (class 2) for power wiring shall be 4 Sq mm for general power wiring and for light and fan points wiring shall be 2.5 sq mm for Circuit and 1.5 sq mm for Point wiring and 6 sq mm for AC/Geyser/Washing Machine.
12. UPS, Essential & non-essential DBs shall be separate. The size of DBs at one location shall be same irrespective of number of circuits connected from the DBs.
13. The wiring and conduit route plan/drawings shall be submitted by the contractor and shall be got approved from the Engineer-in-charge.

14. To facilitate drawing of wires, 18 SWG GI fish wire shall be provided in recessed conduit. MS Conduits laid for other services, like fire alarm, PA system etc., where wiring is not done along IEI works, fish wire shall be invariably drawn.
15. The connection between incoming switch / isolator and bus bar shall be made with suitable size of thimble and cable.
16. Power supply to DBs for Machine room Lifts (MR) 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.
17. Size of distribution board shall be as per number of light / power circuits. All distribution boards shall be double door type. RCCB/ RCBO's / (MCB+ ELCB) of suitable rating shall be provided as main incomer in all DBs'
18. In vertical DBs used for power distribution main incomer shall be MCCB of 35/36KA rating breaking capacity. All vertical DBs shall be treated as Floor/wall Mounted Panel.
19. LT panel shall be cubicle type with IP 55 for outdoor and IP-43 for Indoor protection class and fabricated from approved fabricator as per accepted list attached and shall be equipped with digital type measuring instruments like ammeter, voltmeter, frequency meter, watt meter, multi- function meter etc. as per drawing approved by Engineer In- charge. Any Cable end Box, looping/ Connection Box, Loose wire box above DB's required for termination of cable is to be provided by the agency and no extra cost to be paid.
20. Each floor Panel AND VTPN shall be fabricated from min. 2 mm thick M.S. sheet powder coated with 9 tank process and shall be equipped with 4 pole MCCBs, ACBs, Bus bar, digital Multifunction meter, LED indicating lamp extended rotary handle and all accessories as required.
21. MCCB, if used as incomer then it should have earth fault protection, Double make and break and time delay within the MCCB. Earth leakage modules are not acceptable.
22. 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 HFFR copper wires in PVC/MS Conduit. 15-amp power plug and 5-amp power plug shall be provided at each floor. Wiring of this power plugs shall be done with 4 sq mm HFFR copper wires in MS Conduit. LED Bulk head fittings of suitable rating to provide minimum 100 lux shall be connected with each point of lift shaft.
23. 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 of 35 /36 KA breaking capacity rating shall be provided with microprocessor relay with suitable fault level with adjustable O/L, S/C, protection.
24. All types of panels shall be fabricated from approved firms and strictly as per the 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.

25. 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.
26. Lightning arresters shall be provided for building as per IS: 62305 as amended up to date and CPWD specifications for internal work – 2013 & aviation lights (LED Type) shall also be provided.
27. 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, 2013. Earthing system should be designed such as to maintain earth resistance as specified in CPWD specifications. Earth resistance shall be checked / tested in harsh climatic conditions.
28. Provision is to be taken in to consideration during designing
 - i. Decorative LED mirror light above each wash basin.
 - ii. Tentative power requirement to be provided in areas are as mentioned below.
 - a) In corridor area for each 30 sq. mtr area 1 no. 15 amp power plug, 2 nos. 5 amps light plugs outlets or as per the requirement.
 - b) In other area, for each 10 sq. mtrs area 1 no. 15 amp power plug outlet or as per the requirement shall be provided.
 - c) Each Sitting of Chamber shall have 2 nos. 5 amps Sockets and Switch shall be at above Table to control the sockets and 1 nos. computer outlet comprising of 1 no. 15 amp switch and 2 nos. 5 amps sockets along with LAN Point shall be provided.
 - d) Near each computer outlet one number RJ 45 socket shall be provided. Entire wiring for networking along with all necessary components like Cat- 6A wire, Patch panel, Patch cords, Rack etc. are in the scope of work. The system shall be got approved by the Engineer-in-charge.
 - e) Heavy duty Metallic exhaust fan with louvers as per the requirement of ventilation shall be provided in each toilet.

ADDITIONAL CONDITIONS

1. Specification: - The work shall be executed as per CPWD's General Specification for Electrical Works Part-I (Internal)-2023, Part-II (External)-2023, Part-IV (Sub- station)- 2013, IE Rules, Indian Standards amended upto date and as per direction of Engineer-in-Charge. The additional specifications are to be read with above and in case of any variations, Specifications given along with the tender shall apply.
2. Storage: - Responsibility for storage for execution of work shall be of main contractor.
3. **Power & Water Supply:** - Responsibility for supply of power & water for execution of work

shall be of main contractor.

4. The material required to be used in the work shall be got approved from the Engineering-charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.
5. Contractor shall preserve the copies of invoices, test certificates; gate passes etc. to prove the genuineness of material/purchases. The responsibility of procurement, genuine material of specialized works shall rest with the contractor.
6. No inspection outside the country is permissible if required so the same will be deemed to be waived off and necessary test reports shall be submitted before the dispatch of equipment.
7. Guarantee: All the equipment's shall be guaranteed for a period of 36 months from the date of completion. Any defective materials and equipment shall be replaced free of cost at the direction of the Engineer-in-Charge.

All other any item to commission the system shall be provided by bidder without any extra cost.

Electrical work as per below:

CPWD General Specification for Electrical Works Part I Internal –2018. General Specification for Electrical Works (Part III Lifts & Escalators)-2018 CPWD General Specification for Electrical Works Part IV Substation-2018 CPWD General Specification for Electrical Works Part VII DG Sets –2018.

Note: All above Specifications & other specification, codes & standards mentioned elsewhere in the document shall be applicable with revisions/amendments/correction upto 31.03.2026

General

The special conditions of contract given below shall be read in conjunction with the other documents forming part of the contract. In case of any variance, these conditions shall supersede any other conditions mentioned in any contract document.

The materials, design and workmanship shall satisfy the specifications contained herein and codes referred to. Where the technical specifications stipulate the requirement in addition to those contained in the Standard Codes and specifications those additional requirements shall also be satisfied. In the absence of any Standard / Specifications covering any part of the work covered in this tender document, the instructions / directions of engineer-in-charge will be binding on the contractor.

All Electrical installations shall be of high quality, complete and dully operational including all necessary items and accessories whether or not specified herein. All Electrical work shall be completed in accordance with the regulations and standard to the satisfaction of the Engineer-in-charge.

Scope of work covers planning, designing, supply, installation, testing and commissioning of all E & M services such as IEL, Fire alarm, Public Address System, Electric Fire Monitoring system, Gas Suppression system, Access Control and Security Management System, Emergency Lighting System, Access Control-boom barrier, CCTV, Data Networking, Aviation Light, Lightning Protection system, TV & Telephone System, required to be provided in the said scheme as per norms of various IS codes / NBC 2016 / CPWD specifications/ECBC/CEA, various byelaws and norms of local bodies. The work shall be executed as per scope & specifications of Electrical works given hereafter and given in respective head / part of the scheme sub-head. If any services required to make the bldg. / scheme habitable is not covered in the scope of services same shall either be pointed out in pre-bid meeting else, it shall be presumed that the same shall be provided within the quoted cost and nothing extra shall be paid on this account.

The scope of works also covers the preparation of layout plans, drawings for Electrical schemes and approval of the same from the respective local bodies before the commencement of work. During execution, if the local bodies etc. require a modification, the same shall be executed without 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. All statutory fees / charges required for obtaining clearances from CEA / Local Bodies shall be paid by the agency.

Power supply required for construction shall have to be arranged by the bidder at his own costs i/c required for testing & commissioning. Water required for testing of equipment's is also in scope of agency.

Internal electric installation (IEI)

General Specifications for Electrical Works Part-I (Internal)-2023 and Part-II (External)-2023 with amendments up to the date of opening of bids and the governing specifications, which are mandatory including makes for some of the important materials to be used in the work. In case of ambiguity between the two, the specifications shall prevail.

HFFR insulated Copper conductor wires will be used for points, circuit & sub-main wiring.

Agency shall execute the work as per scale of amenities given elsewhere in document after obtaining necessary approval of the layout for internal electrification of all Chambers, common areas and staircases from Engineer-in-charge. The staircase lighting shall be in

group control system.

Modular type switches, sockets and stepped type electronic fan regulators, bell push along with matching mounting boxes of same make shall be used.

TV outlet point wiring shall be terminated in suitable size of G.I. box along with splitter at every floor. 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.

Telephone outlet point wiring shall be terminated in suitable size of G.I. Junction box direct from ELV Shaft to each Point. However, conduit for telephone wiring may be provided through branching by providing suitable size of G.I. box along with suitable tag block at each floor. The inter connections of all junction boxes fixed at all floors shall be done properly making proper distribution system with the prior approval of Engineer-in-charge. Providing incoming television / telephone cables from the site boundary of building is covered in the scope of this bid. However, pipes for laying of these cables shall also be provided by the bidder as per direction of Engineer-in-Charge.

Suitable rain protection covers made of 16 SWG galvanized MS sheet wherever required shall be provided.

Lighting fixtures of LED Type with wattage and fans for all quarters to be provided by bidder. The model number of fittings and fans shall be got approved by the Engineer-in-charge before execution.

Laying of HDPE / DWC /Hume pipes for road crossing or in pucca portion & CC path etc. for electric / telephone / street lighting cables complete with adequate number of cable chambers shall be provided by the agency.

After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2013 & Indian Electricity Rules 2005, shall be recorded and submitted to the department. The results shall be within the permissible limits. Test report forms duly signed by authorized person for obtaining electric connections (energy meters) from Power Distribution Company by the agency shall be given to the allotted.

Ceiling fans exhaust fans & LED light fixture of suitable wattage, call bell in these buildings shall also be provided by the agency as per direction of Engineer-in-charge.

Lightning arresters as per IS; 62305 as amended up to date & aviation lights (LED Type) shall also be provided by successful bidder.

LT CABLES & CABLE TRAYS: STANDARDS OF CODES

This chapter covers the specifications for supply and laying of Medium Voltage XLPE cables.

All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended up to date. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

CABLES

Medium voltage Armored cables up to 16Sq.mm copper conductor XLPE insulated and above 16Sq.mm aluminum conductor XLPE insulated, PVC sheathed armored conforming to latest IS. Cables shall be rated for a 1100 Volts.

Conductors shall be insulated with high quality XLPE base compound. A common covering (bedding) shall be applied over the laid-up cores by extruded sheath of unvulcanised

compound. Armoring shall be applied below outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer's name and trade mark at every meter length. Cores shall be provided with following colour scheme of PVC insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Core	:	Red and Black
3 Core	:	Red, Yellow and Blue
3 ½ /4 Core	:	Red, Yellow, Blue and Black

LAYING

Cables shall be laid as per the specifications given below:

Duct system

Wherever specified such as road crossing, entry to building or in paved area etc. cables shall be laid in underground ducts. The duct system shall consist of a required number of stone ware pipes, GI, CI or spun reinforced concrete pipe with simplex joints and all the jointing work shall be done according to the CPWD building specifications or as per the instructions of the Engineer-In-Charge as the case may be. The size of the pipe shall not be less than 100mm in diameter for a single cable and shall not be less than 150mm for more than one cable and so on. The pipe shall be laid directly in ground without making any special bed but wherever asbestos cement pipes are used, the pipes shall be encased in concrete of 75mm thick. The ducts shall be properly anchored to prevent any movement. The top surface of the cable ducts shall not be less than 60 cm. below the ground level. The ducts shall be laid a gradient of at least 1:300. The duct shall be provided manholes of adequate size at regular intervals for drawing the cables. The manhole cover and frame shall be of cast iron and machine finished to ensure a perfect joint. The manhole covers shall be installed flush with the ground or paved surfaces. The duct entry to the manholes shall be made leak proof with lead-wool joints. The ducts shall be properly plugged at the ends to prevent entry of water, rodents, etc. Suitable duct markers shall be placed along the run of the cable ducts. The duct markers shall at least be 15 cm. square embedded in concrete, indicating duct. Suitable cable supports made of angle iron shall be provided in the manholes for supporting the cables. Proper identification tags shall be provided for each cable in the manholes.

Cables in outdoor trenches

Cable shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not be less than 75cm from the final ground level. The width of the trenches shall not be less than 45 cm. However, where more than one cable is laid, an axial distance of not less than 15 cm. shall be allowed between the cables. The trenches shall be excavated in reasonably straight line with vertical side walls and with uniform depth. Wherever there is a change in direction suitable curvature shall be provided complying with the requirements. Suitable shoring and propping may be done to avoid caving in of trench walls. The bottom of the trench shall be level and free from stone brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm. in depth.

The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be paved off in one stretch. However, where this is not possible the remainder of the cable may be removed by "Flaking" i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 mtrs. apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line.

For short cut runs and sizes upto 50 sq.mm of cables upto 1.1 KV grade any other suitable method of direct handling and laying can be adopted with the prior approval of the Engineer-in-charge.

When the cable has been properly straightened, the cores are tested for continuity and insulation resistance and the cable length then measured. The ends of all cables shall be sealed immediately. In case of PVC cables suitable moisture seal tape shall be used for this purpose.

Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less 17 cms above the base cushion of sand before the protective cover is laid. In the case of vertical multi tier formation after the first cable has been laid, a sand cushion of 30 cms shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cms as stated above. The top most cable shall have final sand covering not less than 17 cms before the protective cover is laid.

Unless otherwise specified, the cables shall be protected by the second-class bricks of not less 20 cms x 10 cms x 10 cms (nominal size) protection covers placed on top of the sand (bricks to be laid breadth wise) for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at 5 cm. over the sides of the end cables. The trenches shall be taken back filled with excavated earth free from stones or other sharp edge debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm, unless otherwise specified.

Route Marker

Cable route marker marked "Cable" shall be provided along with the route of the cable and location of loops. The route markers shall be of tapered concrete slab of 60 x 60cm at bottom and 50 x 50cm at top having a thickness of 10cm. Cable marker shall be mounted parallel to and 50cm away from the edge of the trench.

Cables in indoor trenches

Cables shall be laid in indoor trenches wherever specified. The trench shall be made of brick masonry with smooth cement mortar finish with suitable removable covers (i.e. precasted slabs or chequered plates). The dimensions of the trenches shall be determined depending upon the maximum number of cables that is expected to be accommodated and can be conveniently laid. Cables shall be arranged in tier formation in trenches and if necessary, cables may be fixed with clamps. Suitable clamps, hooks and saddles shall be used for securing the cables in position. Spacing between the cables shall not be less than 15 cm centre to centre. Wherever specified, trenches shall be filled with fine sand and covered with RCC or steel chequered trench covers.

Cable on Trays/Racks

Cable shall be laid on cable trays/racks wherever specified. Cable racks/trays shall be of ladder, trough or channel design suitable for the purpose. The nominal depth of the trays/racks shall be 150 mm. The width of the trays shall be made of steel or aluminium. The trays/racks shall be completed with end plates, tees, elbows, risers, and all necessary hardware, entire steel trays/ racks shall be hot dip galvanized including widths & accessories. Cable trays shall be erected properly to present a neat and clean appearance. Suitable cleats or saddles made of aluminium strips with PVC covering shall be used for securing the cables to the cable trays. The cable trays shall comply with the following requirements:

The tray shall have suitable strength and rigidity to provide adequate support for all contained cables.

It shall not present sharp edges, burrs or projections injurious to the insulation of

wiring/cables.

If made of metal, it shall be adequately protected against corrosion or shall be made of corrosion-resistant material.

It shall have side rails or equivalent structural members.

It shall include fittings or other suitable means for changes in direction and elevation of runs.

INSTALLATION

Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid.

Each run of the cable tray shall be completed before the installation of cables.

In portions where additional protection is required, non combustible covers/ enclosures shall be used.

Cable trays shall be exposed and accessible.

Where cables of different system are installed on the same cable tray, noncombustible, solid barriers shall be used for segregating the cables.

Cable trays shall be grounded by two nos., earth continuity wires. Cable trays shall not be used as equipment grounding conductors.

At no place the cable tray/ rack/ ladder running horizontally should rest on any building partition like Brick wall, RCC beams etc. but instead proper MS supports/ hangers to be provided at minimum of 1500 mm intervals and at every Turning Angles.

Jointing and termination's

Cable jointing shall be done as per the recommendations of the cable manufacturer. All jointing work shall be done only by qualified/licensed cable jointer.

All jointing pits shall be of sufficient dimensions as to allow easy and comfortable working.

Jointing materials and accessories like conductor, ferrules, solder, flex, insulating and protective tapes, filling compound, jointing box etc. of right quality and correct sizes, confirming to relevant Indian Standards.

Each termination shall be carried out using brass compression glands and cable sockets. Hydraulic crimping tool shall be used for making the end terminations. Cable gland shall be bonded to the earth by using suitable size copper wire/tape.

LOW VOLTAGE, INTERNAL & EXTERNAL ELECTRICAL SYSTEM: CONDUITING AND WIRING FOR TV SYSTEM: -

CONDUITING

Conduiting for ELV works such as TV, Fire Alarm & PA system shall be carried out in MS Conduit (If surface) else Pvc Conduit (concealed in slab) shall be used. All Conduiting will be laid concealed in slab unless otherwise it is directed to be laid on surface by Engineer-In- Charge.

OUTLETS

All TV 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.

JUNCTION BOX

Suitable size of metallic junction box shall be provided for termination of conduit for TV

system. Box shall be made of 1.6mm thick MS sheet and shall be treated before painting. Front of the junction box shall be provided with 3mm thick phenolic laminated sheet cover.

COAXIAL CABLES

The coaxial cable shall be of wideband type (RG-11 for Riser & RG-6 for distribution)

TAP OFF

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.

SPLITTERS

These shall be of ultra wide band width 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 splitters shall be in 2 way, 3 way & 4 way configurations

INTERNAL & EXTERNAL ELECTRICAL SYSTEM

General Specifications for Electrical Works Part-I (Internal)-2013 and Part-II (External)-1994 with amendments up to the date of opening of bids and the governing specifications, which are mandatory including makes for some of the important materials to be used in the work. In case of ambiguity between the two, the specifications shall prevail.

Following system also need to be considered for **Griha-3** rating and to be provided by EPC agency.

Automatic lighting shutoff shall be provided through PIR based occupancy sensors. All Motors shall be as per Griha-3 rating.

20% reduction in LPD as per ECBC 2007 or Latest shall be maintained.

All Exterior lighting shall be controlled by photo sensor or astronomical time switch.

Exit signs shall not exceed 5W per face. All Motors shall be as per latest ECBC.

Metering shall be monitored as per following as per Griha – 3 and to be provided by EPC agency.

UPS

Lighting (Indoor and Outdoor lighting) Plumbing systems

Common Areas

Lifts and common areas

33 KV METERING AND 33 KV VCB PANEL

H.T. METERING PANEL (INDOOR TYPE): GENERAL

H.T. Metering Panel shall be made as per regulation of Local Electricity Supply Authority.

CODES AND STANDARDS

The 11 H.T. Metering Panel shall comply with the following standards as amended up to date.

IS: 2544

: Bus Bar Supports

IS: 2705 / IEC – 185 : Current Transformer

IS: 3516 / IEC – 186 : Potential Transformer

SUBMITTALS

SHOP DRAWING AND TECHNICAL DATA

The Tenderer shall furnish relevant technical data on H.T. Metering Panel and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on b r e a k e r s and associated equipment and the following for approval before manufacture of the panel.

- a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering and relay compartment and terminal blocks for external wiring connections.
- b) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.
- c) All drawings and data shall be in English.

TYPE AND CONSTRUCTION

The metal clad panel shall be made out of 2.0 mm thick CRCA sheet steel. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphating process and shall then be given powder coating (Electrostatic) paint of manufacturer's standard shade.

- a. C.T. & P.T. Compartment
- b. Energy Meter Compartment
- c. Cable Termination Compartment

The compartments shall be dust & vermin proof and safe to touch. The H.T. Metering Panel shall be suitable for cable termination from bottom only. The Panel shall be supplied with all equipment mentioned in BOQ and as per regulation of Local Electricity Supply Authority.

33 KV VCB PANEL SCOPE

This specification covers design, engineering, manufacture, shop testing, delivery at site, erection, testing and commissioning of type tested 36 KV or 12 KV, 3 phase, metal clad indoor, Horizontal draw out type, Vacuum Circuit Breaker (VCB) Switchboard with all accessories and protective devices mounted and wired up.

CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of the Switch Board offered shall comply with all currently/latest applicable standards (including amendments thereto), regulations and safety codes in the locality where the equipment's will be installed. Nothing in this specification shall be construed to relieve the Supplier of his responsibility. Where no standards are available, the supply items shall be of good quality and workmanship and backed by test results. Other National Standards are acceptable if t h e y are established to be equivalent to or superior to the listed standards.

Standards		
	IEC: 62271 - 1	High-voltage switchgear and control gear - Common specifications.

	IEC: 62271 - 100	High-voltage switchgear and control gear Alternating current circuit-breakers.
	IEC: 62271 - 200	High-voltage switchgear and control gear - AC metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.
	IEC: 600441-1	Current Transformers
	IEC: 600441-2	Voltage Transformers
	IEC: 60529	Classification of degrees of protection provided by enclosures
	IEC: 60038	Standard Voltages
	IEC: 60255	Measuring relays and protection equipment - Part 24 Common format for transient data exchange (COMTRADE) for power systems.
	ANSI IEEE 37/20	(Switch gear assemblies including metal enclosed bus

CIRCUIT BREAKER

The circuit breaker shall be mounted on a with draw able truck which shall roll out horizontally from service position to isolated position with ease and it shall also be possible to take out the breaker truck from cubicle smoothly on to the floor without use of any separate handling equipment. It is preferable to provide three-point guide for withdrawal and insertion of truck into the cubicle with ball bearing arrangement on the top of the truck. Circuit breaker shall be of vacuum only and the truck shall have distinct 'SERVICE' and 'TEST' position. Isolated position by defeating the interlock shall also be inside the cubicle so that the front door of breaker compartment can be closed even in breaker isolated position. Special more than three-point hinged locking arrangement shall be provided to prevent opening of door in the event of internal arc in breaker compartment. Isolation shall be horizontal.

All the three interrupters of individual phases shall be mounted on a common phase segregated epoxy body mounted on a truck for better insulation and avoidance of non-simultaneity of poles. Circuit breaker shall be vacuum type only. Bidders should be the manufacturer of vacuum interrupter as pre requisite for qualifying. Interrupter mounted on the conventional individual insulators will not be accepted. No separate fiberglass sheet barrier to be used.

It shall be operated through a common motor wound spring charged mechanism with electrical release coil for closing and shunt trip coil for tripping. Operating mechanism must have manual charging, closing and tripping facility with the provision locking facility in push to close & push to trip mechanical push button.

The mechanism shall be such that motor will automatically recharge the mechanism springs after a closing operation enabling breaker to perform OCO operation. The charging time of motor shall be less than 15 second making it suitable for rapid auto reclosing duty. Emergency mechanical push to trip button shall be provided for emergency manual tripping with front door closed. All the 'MS' components of circuit breaker mechanism shall be treated with zinc plating with olive green passivation for longer life even in adverse climatic condition. Yellow passivation shall not be acceptable. All mechanism springs shall be powder coated. Plating on mechanism spring is not acceptable. The normal current rating of circuit breaker shall be in panel rating without fan.

There shall be minimum 4 NO and 4 NC contacts in breaker auxiliary switch. In case of Additional contacts, the same can be multiplied through latched type contactors. Auxiliary plug and socket shall be of minimum 24 pin plug type and shall have scrapping earth feature. Auxiliary contacts shall be suitable for continuous thermal current rating of 10A.

INTERLOCKS

Circuit breaker can be inserted only in open position. Likewise, circuit breaker in closed position cannot be withdrawn. Attempt to draw out closed breaker shall not trip the breaker.

The circuit breaker shall operate only in one of the three defined positions i.e. service, test and isolated. The breaker shall not close in any of the intermediate positions. The circuit breaker cannot be inserted into service position till auxiliary contacts are made. Similarly interlock prevent auxiliary contacts from being disconnected, if circuit breaker is in service position.

It will not be possible to rack out the with draw able part from Service to Test position when the switching device is switched ON. Similarly, it will not be possible to rack in the with draw able part from Test to Service position, if the switching device is switched ON.

Any attempt to rack out with draw able part from Service to Test position will not result in switching OFF of the Circuit Breaker instead the Service position will be locked till switching device is 'ON'.

It will not be possible to rack in or rack out with draw able truck when the front high voltage door is open. However, a suitable defeat interlock mechanism is provided for emergency purpose.

It will not be possible to rack in the with draw able truck from test to service position when the low voltage control plug is not in position and locked on the truck itself.

It will not be possible to close the door if the low voltage control plug is not engaged.

BUSBARS

Bus bar material shall be Electrolytic Copper.

All bus bars shall be insulated with heat shrinkable PVC sleeves. Joints shall be insulated with shrouds in bus bar chamber and interphase barrier shall be provided in cable chamber.

Phase identification shall be made at the end by colored tape.

Bus bars shall be mounted on integral seal off bushings while passing from one compartment to another except bus bar compartment.

Bus bar shall run throughout the switchgear without interruption so in case of any arc, arc shall travel and cause minimum damage to the switchgear.

Temperature Rise of bus bar along with other parts of switchgear shall be governed by IEC 60694, Table III.

CUBICLE CONSTRUCTION

The switchgear panel shall be of sheet steel construction with ALUZINC not less than 2.5mm thickness for load bearing section and not less than 2 mm thickness for non-load bearing and shall totally dust and vermin proof. The panels shall be rigid without using any external bracings. The switchboard panels should comply with relevant IS/IEC and revision thereof and shall be designed for easy operation maintenance and further extension. Bus bar, metering circuit breaker chamber, cables and cable box chamber should have proper access for maintenance, proper interlocks should be provided. All instruments shall be non-draw out type and safe guard in every respect from damages and provided with mechanical indicator of connection and disconnection position. The switchgear shall be completed with all necessary wiring fuses, auxiliary contacts terminal boards etc.

Width of cubicle is 1100mm up to 1250A and 1200 mm above 1250A.

Joints for All front door shall be provided with neoprene or cross linked poly ethylene gaskets self-adhesive type

All the high voltage compartments must have pressure discharge flap for the exit of gas due to internal arc to ensure operator safety. All the HV compartment design i.e. Bus bar compartment, VCB compartment and Cable compartment should ensure conformity to IEC 62271-200 and must be type tested individually for Internal Arc Test for AFLR 18.37kA for 100ms. The switchgear panels shall be suitable for loss of service continuity LSC 2B. Safety shutters complying with IEC-62271-200 shall be provided to cover up the fixed high voltage contacts on bus bar and cable sides when the truck is moved to ISOLATED position.

Safety shutters shall be metallic and shall be provided to cover up the fixed High voltage

contacts on bus bar and cable sides when the truck is moved to Test/ isolated position. The shutters shall move automatically, through a Linkage with the movement of the truck and shall be of gravity fall type only. It shall be possible to padlock shutters individually.

Switch gear cubicle shall have seal off bushing arrangement between the circuit breaker compartment and bus bar/ C.T. cum cable compartment, i.e. the fixed isolating contacts shall be embedded in epoxy cast bushing so the these act as seal off bushing to prevent transfer of arc from one compartment to the other in the event of internal arc within the cubicle & must be tested for internal arc in all three HV compartments as per new IEC 62271-200.

Louvers can be provided for higher normal current rating however, same shall be backed up by fine wire mesh.

Joints for All front door shall be provided with neoprene or cross linked poly ethylene gaskets self-adhesive type. For Compressibility step type channel base shall be provided for easy compressibility. It shall be preferable to provide cross linked poly ethylene type. It shall be preferable to supply cubicle with gaskets between all metal-to-metal proper vermin proof. Minimum degree of protection shall be IP4X.

LOW VOLTAGE COMPARTMENT

Low voltage compartment shall be mounted at the front on the top of breaker compartment and shall also have hinged type of door.

All wiring shall be routed through PVC ducts and shall be terminated on to stud type terminal with plastic cover.

For current transformer terminal shall be disconnecting link type only.

The wire shall be of 1.1KV grade and suitable for 2 KVrms for 1 minute power frequency high voltage.

CABLE COMPARTMENT

It shall be at the rear side with rear bolted box type back covers. There shall be an inspection window at the rear back cover enabling operator to have visual inspection without opening back cover in live condition. Viewing window at the rear side shall be of poly carbonate only and shall be tested for internal arc.

The gland plate of cable chamber shall be of minimum 3mm thickness MS sheet in two halves section with built in adjustable cable holding clamp. In case of single core cable, it shall be supplied with non-magnetic gland plate. Cable box shall accommodate 2-3Core 630 sq. mm. Cables or 6-1C cables. Addition rear extension box of minimum 500 mm depth shall be provided for cables more than the quantity mentioned above.

Sufficient headroom shall be provided for cable termination. The distance between gland plate and terminal shall be minimum 600mm.

Control cable entry shall be from front and there should be a possibility of terminating to LV chamber from both right hand and left-hand side. Power cable entry shall be from rear bottom. Provision shall be available for entry of power cable or bus duct from rear bottom or rear top.

EARTHING

There shall be a continuous copper earth bus of size 50x6 sq. mm running at the bottom of the panel. Earth bus shall be robust and shall be capable of carrying full short circuit current for 1 second. Doors, covers and all non-current carrying metallic parts shall be earthed through flexible copper wires. This also includes instrument casing and cable armour which are also connected to the earth bus. Earth bus must be tested for 18.37KA for 1 sec

Separate earthing truck shall be provided for bus earthing and cable earthing. The earthing truck shall be so designed that it is impossible to earth a live. It shall be provided with capacitive voltage divider and complete with audio visual annunciation.

In addition to scrapping earth in auxiliary plug and socket proper arrangement should be made so that during engagement of the breaker in service condition earthing contacts is made first before isolating power contacts are engaged.

CURRENT AND POTENTIAL TRANSFORMER

Current transformers shall be double core window/bar primary for higher rating or wound primary for lower rating. Maximum VA burden shall be of 15 VA and shall be rated for full short circuit current for 1 second. Differential /REF CTs can be in one mould. In case of numerical relays 10VA burden shall be sufficient. CT shall be of a minimum accuracy of class 0.5/5P10 and CT Secondary rating shall be 1A unless otherwise specified.

Potential transformer shall be 3phase 3 limb type with 50VA per phase of class 0.5/3P accuracy and shall be mounted on incomer breaker truck. For bus connected P.T the same shall be mounted in a separate with draw able truck in a separate vertical panel.

PROTECTION RELAYS

The Protective IDMT O/C, E/F relays should be of numerical type with the same technical specification. The relay should have feature for storing fault data, should have site selectable CT secondary relay currents i.e. -/5 Amps or -/1 Amps. Should have LED/LCD for each function element of a relay to enable to identify the type of fault condition.

All the switchgears shall be provided with microprocessor based numerical protective relays of approved (Top Makes) make designed to disconnect faulty circuit with speed and discrimination and shall conform to latest revision of relevant standards regarding accuracy and other feature. Composite relay unit having O/C, E/F, O/V, U/V etc. shall be preferred. The numerical relays shall be communicable type and shall communicate on MODBUS protocol. Use of communication protocol converter is not acceptable. Min 10 DI/DO have to be provided.

Every Panel should have Arc Flash Protection in Cable and Bus Bar Chamber. Protection of Various type of feeders as follows:

Incomer:

1 No of **SCADA 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 (Auto reclose), 50BF (Circuit breaker failure detection), Cold load pick up, Inrush blocking. Relay will be on Modbus Protocol

Master Trip Relay

Outgoing Transformer Feeder

1No. of SCADA 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 (Auto reclose), 50BF (Circuit breaker failure detection), Cold load pick up, Inrush blocking. Relay will be on Protocol.

Master Trip Relay

Transformer Fault Alarm/Trip Aux. Relay. For Transformer Feeder only.

METERING

Ammeter & voltmeter selector switches shall be four position type. Ammeter selector switches shall have made before break feature to prevent open circuiting of CT secondary. Selector switch shall be suitable for semi flush mounting with only switch front plate and operating handle projecting out.

Multifunction meter: Digital type (Displaying A, V, PF, Hz, KVA, KW, KVAR, KWh, KVARh etc.) Class 0.5 with RS485 port for communication in Modbus protocol.

AUXILIARY/CONTROL WIRING

Control supply for closing and tripping shall be 220 or 110Volts D.C. through external battery source. 230 Volts single phase A.C. supply shall also be available for the operation of spring charging motor and cubicle space heater. Wattage of closing and tripping coils shall be within 250 watts. Aux supply shall be suitably distributed along with switchgear in loop in loop out fashion.

All Switchgear panels shall be supplied completely wired internally upto the terminal block ready to receive external cabling.

All the secondary wiring in the panel shall have high quality PVC insulation and the same shall have conductor size of not less than 1.5 mm² of copper.

Colors of the secondary/auxiliary wiring should confirm to IS 375/1963 and latest amendment thereof if any. All wiring shall be neatly run and group of wiring shall be securely fixed by clips so that wiring can be checked without necessity of removing the clamps. Wiring between fixed and moving portion of the panel shall be run in flexible tubes and the same shall be so mounted to avoid any damage to them due to mechanical movements. Ferrules with number shall be provided on both end of the wiring.

All wires directly connected to trip the circuit breaker shall be distinguished by the addition of a red colored unlettered ferrule

PRE-TREATMENT AND PAINTING

Switchgear front and rear covers shall be painted for aesthetic purposes and Paint shade shall be RAL 7032.

NAME PLATE AND DIAGRAM PLATES

All equipment shall have weather proof and non-corrosive metal plates fixed in suitable position with full particulars engraved thereon with white letters against black background.

The firm shall affix a name plate on each Switchgear panel having following information:

Manufacturer's name

Type of Panel. CT Ratio.

Rated Voltage.

Rated Insulation Level

Rated Frequency Rated Normal Current

Rated Short Circuit Breaking Current. Order No. and Date

Year of supply.

TESTS

The design of circuit breaker shall be proven through all the routine and type tests in accordance with IS IEC 62271-200 and any amendment thereof. Photocopy of all the test reports must be enclosed with the tender. Type test report earlier than 5 years from the date of tender opening shall not be acceptable.

The Bidder shall submit the type test reports of following type tests for approval of the Purchaser

Short circuit duty test on circuit breaker, mounted inside the panel offered. Short time withstand test – on circuit breaker, mount inside panel offered. Power frequency withstand test on breaker and panel.

Lightning impulse withstand test on breaker and panel. Temperature rise test on breaker and panel together.

Measurement of resistance of main circuit. Mechanical endurance test on breaker.

Mechanical operation test.

Internal arc current (IAC) test on individual compartments i.e. Bus bar, VCB and cable compartment.

QUALIFYING REQUIREMENT.

Having supplied minimum 1000 nos. VCB of minimum 25KA fault rating.

33 KV/ 0.433 KV TRANSFORMER (Oil/Dry Type with outdoor) GENERAL:

The work shall be carried out as per CPWD General Specifications for Electric al Works (Part -IV- Sub Station) 2013 as amended upto date ones conforming to I.S. specifications.

TRANSFORMER (Oil/Dry TYPE, ECBC): Losses shall be as per **Griha 3 star** and Losses shall be measured by using calibrated digital meters of class 0.5 or better. For transformers of capacity equivalent or above 500 KVA shall be equipped with additional current transformers (CTs) and potential transformers (PTs) for loss monitoring.

The transformer shall comply with the latest edition of the relevant Indian Standards / Manual. The transformer shall be copper double wound core type, oil natural air natural cooled suitable for outdoor installation. The transformer shall be designed and manufactured as per latest relevant IS /BS with up-to-date amendments. Transformer shall be suitable for continuous rating as stated in BOQ and on drawings. The transformer winding shall be of electrolytic copper conductors covered with a special material having high tensile and dielectric strength. The Core shall be made up of high-grade low loss cold rolled grain-oriented steel sheets (CRGO). Core shall be treated with high temperature resistant paint to prevent corrosion at edges of the core plates. Distribution Transformer with on load tap changer, Balanced supply and unbalanced load.

INPUT	:	33 KV ,3Phase,3Wire,50Hz.
OUTPUT	:	0.433KV,3Phases,4Wire,50Hz.
RATING	:	2000 KVA Oil Type (3 Nos. Each)
VECTOR GROUP	:	Dyn-11
OCTC	:	15.0% to +5.0% in step of 1.25% (17 Steps) on load tap changer
TEMP RISE	:	As per Indian Standard. WINDING TEMP RISE : As per IS 1180.

LOAD LOSSES: Max. Allowable losses for Oil type transformer at 33KV on 50% and 100% of the load shall be as per Energy Efficiently, ECBC.

Generally, the transformer shall conform to IS:2026-1 and unless otherwise stated following standards shall be applicable and latest amended up to date.

- i) IS: 3839
- ii) IS: 6600
- iii) IS: 335
- iv) IS: 1271
- v) IS: 2099
- vi) IS: 3639
- vii) IS: 2147
- viii) IS: 3202
- xi) IS: 2705
- x) IS: 10028 (Part II & III): installation & maintenance o

TANKS & RADIATORS

Tanks shall be of MS. plates and structures, electrically welded. The construction shall be robust and substantial, suitable for road/ rail transport and to withstand vibration. Radiator tubes shall be electrical resistance welded type, round or elliptical or rectangular. They may be welded to the transformer tank or in case of very large sizes to separate detachable radiator banks connected through intermediate leak proof valves. Detachable radiator banks shall have top and bottom headers with flanged connections, with drain and vent fittings. Tanks shall be provided with lifting lugs and jacking lugs. Inspection hole with cover should also be provided for large transformers.

Tanks shall be thoroughly cleaned, degreased and sand blasted inside and outside. A coat of rust resisting primer shall immediately be given on outside surface. Inside surface shall be painted with oil resistance enamel paint. Tank and radiators shall be hydraulically pressure tested. Tanks shall also be tested for full vacuum.

TESTS

The transformer shall be subjected to the following routine tests at the manufacturer's works before dispatch.

- a) Measurement of winding resistance.
- b) Voltage ratio, polarity and phase relationship.
- c) Measurement of impedance voltage.
- d) Load losses.
- e) No load losses and no-load current.
- f) Induced over voltage withstand.
- g) Separate source voltage withstands.
- i) Vector group.
- j) DV/DF Test.
- k) Magnetic Balance Test.
- l) High Voltage Test.
- m) Insulation Resistance Test
- n) All other specified in relevant BS Code.

The quoted rate for the transformer shall include all routine tests to be carried out at the manufacturer's works and all routine tests to be carried out at site as per specifications. The contractor shall quote separately for type tests, which shall be carried out only on the written instructions of Owner. The supplier shall give sufficient advance information about the test schedule to enable the owner to appoint his representative.

Testing at Site:

Prior to commissioning of the transformer, the following tests shall be performed.

- a) Insulation resistance of the winding between phases and earth of H.V and

M.V. Side.

- b) Voltage ratio test at principal tap, minimum tap & maximum tap position
- c) Magnetic Balance Test.
- d) Performance/Settings of winding Temperature Indicator, Oil Temperature Indicator.
- e) Insulation Resistance Test

Accessories:

Accessories as specified in the attached Data Sheet shall be included in the scope of supply. The tapping and control gears shall be provided on the H.V. side. Tap changer shall be off-circuit type as specified in Data Sheet. The tap charging equipment shall be suitable for carrying the fault current.

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.

Winding Temperature Indicator (WTI) Shall comprise of:

Temperature sensing element Image coil

Bushing or C.T.

Local indicating instrument with electrically independent trip/alarm contact brought out to separate terminals.

Painting:

All metal parts shall be thoroughly cleaned to remove rust, scale, grease etc. and painted with two coats of approved color shade over one coat of rust resisting primer. The paint shall not scale-off, crinkle or removed due to normal handling.

All metal surfaces not accessible for painting shall be made of corrosion resistant material.

Rating Plate Details:

Each transformer shall be provided with a rating plate giving the details as per Standard or latest amendment upto date. The marking shall be indelible and the rating plate shall be located on the front side.

Exact value of transformer % impedance, as determined by tests shall be marked on it and also on the final submission of nameplate.

Drawing & Documents:

- i. All drawings and documents shall be submitted as per the requirements specified in vendor data.
- ii. Complete technical particulars as per Appendix-B of IS 1 latest amendment upto date as applicable to Oil Type Transformers shall be furnished with the quotation.
- iii. Make and type of various accessories and protective devices shall be furnished with the quotation.

Guarantee:

The transformer shall be guaranteed for trouble-free service for the period of 12 months from the date of commissioning or 18 months from the date of receipt at site, whichever, is earlier. Any defects discovered during this period shall be rectified free of charge.

Information Required with Bids

Clause-wise deviations to this specification. If the same are not furnished it will be assumed that the offered equipment meet the enquiry specifications in to.

Information as sought in clause 10.0

GA drawing of each rating covered in BOQ. True un-priced copy of the priced bid.

DATA TO BE FURNISHED TRANSFORMER:

1. Name of Manufacturer
2. Standards followed in design manufacture and testing 3. Continuous maximum rating in KVA
4. Transformer no-load voltage 5. High voltage
6. Low voltage
7. Vector group reference 8. Terminal Arrangement 8(A) H.V. Side 8(B) L.V. Side
9. One-minute dry power frequency test withstand voltage in KV
- (I) High voltage :
- (II) Low voltage
10. Impulse test withstand voltage with 1.2 x 50 microseconds wave in KV 11. Type of tap changer
- 11(A) No. of plus taps 11(B) No. of minus taps
12. Iron losses in KW at rated voltage and
13. frequency :
14. Copper losses in KW at rated full load current and frequency at 75 OC
15. Reactance voltage with guaranteed tolerance in percent at rated full load current and frequency 75 OC :
16. Impedance voltage with guaranteed tolerance in percent at rated full load current and Frequency at 75 OC
17. Regulation in percent of no-load voltage at full load current at 75 degree C and With power factors of
- (I) Unity (II) 0.8 lagging
18. Efficiency in percent at 75 degC and unity power factor for : (I) 100 percent load (II) 75 percent load (III) 50 percent load
19. No-load current in amperes at rated voltage and frequency 20. Inrush magnetizing current in percent of normal full load current.
21. Details of winding insulation: (I) Class of insulation materials:
- (II) Turns insulation high voltage in mega ohm : (III) Turns insulation low voltage in mega ohms : (IV) Insulation core to low voltage in mega ohms : (V) Insulation high voltage to low voltage in mega ohms
22. Details of 415 V neutral current transformer (I) Name of manufacturer
- (II) Current ratio (III) VA capacity
- (IV) Accuracy & performance characteristics :

23. Weights

- (I) Core and windings in kg : (II) Complete transformer

24. Overall Dimensions (I) Length in mm (II) Breadth in mm (III) Height in mm

25. TESTS

- (I) List of tests proposed to be carried out at the factory
- (II) List of tests proposed to be carried out at the site before commissioning

26. INFORMATION TO BE FURNISHED BY THE MANUFACTURER:

- *Positive sequence impedance at maximum voltage tap.
- *Positive sequence impedance at minimum voltage tap.
- *Zero sequence impedance at principal tap.
- *Efficiency at 75°C winding temperature:
 - *At full load
 - At 75% full load At 50% full load
 - *Maximum efficiency and load at which it occurs.
- *Regulation at full load at 75°C winding temperature at: Unity power factor
0.85 power factor lag.
- *Resistance per phase of: (I)H.V. winding: Ohms (II)L.V. winding: Ohms
- 27. Conductor area (sq.cm) and current density (Amps/cm²) (I)HV winding
(II)LV winding
- 28. Type of windings (I)HV
(II)LV
- 29. Insulating materials for interterm insulation: (I)HV winding
(II)LV winding
- 30. Insulating materials for winding insulation (I)Insulating materials
(II)Winding and core 31. Laminations of the core.
- 32. Make, type, dial rise, number of contacts and contact ratings (current following items, if provided).
- 33. Dial type thermometer. 34. Winding temperature indicator.
- 35. Thermal with-stand capability under full short circuit conditions in terms of number of times of calculation of short circuit and corresponding anticipation percentage reduction in transformer life. Relevant calculations shall be submitted.

DRAWINGS

The following drawings shall be submitted to Engineer-in-charge for approval in the stipulated time.

Weeks after award of contract

General outline drawings showing plan, front elevation, rear elevation, cable boxes / disconnecting chamber section views, location & dimensions of cable entries, terminals foundation floor fixing details and weights

Bushings:

Plan, elevation terminals details, mounting details make and type number, current and voltage rating, creepage distances and principal characteristics.

Rating and diagram plate

Marshalling box terminal connections, wiring diagram

TEST REPORTS

Test results shall be corrected to a reference temperature of 75 DEG C.

Two copies of test results shall be submitted for the Owner's/Consultants approval before dispatch of transformer.

Additional bound copies, as required by the Owners/Consultants contract, of complete test results including all tests on transformer, bushing, current transformer (if provided), shall be furnished with the transformer.

MEDIUM VOLTAGE PANELS GENERAL

Medium Voltage (up to 1100 Volt) power control centers (generally termed as switchboard panels) shall be in sheet steel clad cubicle pattern, free floor standing type, totally enclosed, compartmentalized design having multi-tier arrangement of the incomers and feeders as per details given in the schedule of quantities. The panels shall be of extensible type with provision of bus bar extensions. All panels shall conform to the requirements of the latest

addition of IS and shall be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

CONSTRUCTION

All switch board panels or power control centers of free-standing type shall have a bus bar chamber at the top and the cable compartment at the bottom or as approved by the Developer/Consultants depending upon the specific requirements of the job. The space between the bus chamber and cable compartment shall be suitably compartmentalized to accommodate either air circuit breakers or molded case circuit breaker of various ratings. The cable terminations shall be carried out on the rear side of the panels for which adequate space and clamping arrangements shall be provided. Where panels have to be installed with very little access space at the rear, the cable terminations shall be carried out in suitable cable alleys provided on the front of the panel. All the live parts shall be properly shrouded with Bakelite barriers. All the equipment shall be accessible from the front. However, protection relays, KWH meters, etc. may be mounted on the rear side/front side. Arrangements and marking of bus bars, main connections and wiring shall be in accordance with latest IS code. The structure of the panel shall be robust and provided with adequate bracings to withstand the operation of the equipment and stresses due to system short circuit. The panels shall be fabricated out of best quality heavy gauge sheet steel. The panel shall be machine pressed with punched openings for meters, indicating lamps etc.

DIMENSIONS

All power control centers shall have dimensions of not more than that given on the layout drawings. Panels arranged side by side shall have the same height and depth. The height of the panel should be limited to 2400 mm. All the operating levers, handles etc. of the highest unit shall not be at a height more than 1700 mm from F.F.L. For all incoming cables a removable gland plate will be provided in the panel and a minimum distance of 300 mm will be provided between the gland plate and the nearest terminal for proper dressing and termination of the cable. All the components of a module will be mounted on a component plate using the machine screws and taped holes (excepting the components mounted on the door). These component plates should be fixed with bolts for easy replacement. Standardization will be adopted while making these plates so that the component plates of the same size modules can be changed from one module to another. In case of panel of lengths more than 4 meters the fabrication of any single section will be limited to a maximum length of 4 meters for the purpose of shipping and shifting at the site. These sections will be assembled at the location of installation with the help of nuts and bolts. While making these sections consideration will be given to the place of sectionalization and select the location where the minimum electrical connections are transferred from one section to another. All the hardware used in the assembly will be electroplated for protection and neat appearance.

BUS BARS

The bus bars shall be suitable for 4 wire, 415 Volts, 50 Hz, system. The main bus bar shall be made of high conductivity electricity conductor grade electrolytic AL 91E Aluminum or Copper and shall be liberally sized. In case of copper bus bar, it shall be electrically conductor grade electrolytic copper and at the time of joining of two copper buses tinning will be done on the copper strips ends to a length equal to the lap length of the joint plus one each. The bus bars shall have uniform cross section throughout. The bus bars shall be capable of carrying the rated current at 415 Volts continuously. The bus bar will run in a separate bus bar chamber using bus insulators made of non-deteriorating, vermin proof, non-hygroscopic materials such as epoxy fiber, reinforced polyester or molding compound. The interval between the two

insulators will be designed after considering:

Strength and safe load rating of the insulator,

The vibrating force generated during a fault, A Factor of safety of 1.8

A set of insulators at both ends of the bus.

The size of the bus bar calculations must be approved by the consultants. The bus bars shall be designed to withstand a temperature rise of 45 degrees above the ambient. To limit the temperature, rise in the bus bar chamber a set of louvers can be provided at strategically places considering the air circulation. The louvers provided will have a brass wire mesh covering from inside with more than 100 openings per sq. inch. The overall temperature of bus bar shall not exceed 85°C in any case.

All the bus bars shall be insulated with PVC heat shrinking sleeves suitably throughout (except at joints) the length. The electro galvanized high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bar. A minimum of 1.6 times the width of bus bar will be the lapping length of each joint.

EARTHING

The panels shall be provided with an aluminum or copper plate earth and bus of suitable size running throughout the length of the switchboard. Suitable earthing eyes/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts. Only aluminum or copper Plate earthing shall be provided for each requirement.

INTERLOCKING

The panels shall be provided with the following interlocking arrangement.

The door of the switch-fuse compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in 'OFF' position. De-interlocking arrangement shall also be provided for occasional inspection.

It shall not be possible for the breaker to be withdrawn when in 'ON' position.

It shall not be possible for the breakers to be switched on unless it is either in fully inserted positions or for testing purposes in fully isolated position.

The breaker shall be capable of being raked in to 'testing' 'isolated' and 'maintenance' positions and kept locked in any of this position.

A safety latch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

PROTECTION & INSTRUMENTATION

Protection and instrumentation shall be as per standard specifications.

CONTROL WIRING

The control wiring of all the panels will be done with FRLS PVC single core flexible copper wires of cross section 2.5 sq. mm. All the wiring involving current transformers or circuits with currents of more than 5 Amps will be wired with 4.0 sq. mm cross section wire and the others with 2.5 sq. mm. Similarly, all the interconnecting between the incoming bus and the outgoing of 100 Amps and above rating shall be done by insulated copper strips of suitable sizes and equipment below 100 Amps rating shall be wired with insulated copper conductors. All of the control wiring will be done by properly dressing all the wires in a laminar manner either in a PVC duct of liberal size or bunched together by PVC strapping tapes at a distance

not exceeding 150 mm. Each wire will terminate with a copper ferule crimped to the wire. The PVC ferules will be used to identify each wire of the circuit and the same number will be marked on the drawing for the corresponding wire. Only one outgoing wire will be connected to one connector. When the control wiring is crossing from fixed parts to moving parts such as door etc. the wire will be run in PVC sleeve of suitable size and the same will be mechanically clamped at both the ends i.e. one end of the fixed part and the other on the moving part. Under no circumstances the wiring should be under any kind of stress for which sufficient length of control wiring in the PVC sleeve should be provided. All the potential circuits shall be protected by fuses mounted near the tap off point from the main connections.

SURFACE TREATMENT

Each part of the fabricated panel will be subjected to seven tank treatment and all sheet metal accessories and components of power control centers and switchboard panels shall be thoroughly cleaned, degreased, de-rusted and hot dip phosphatized before red oxide primer is applied. The panel shall be stove enameled gray shade finish and the Interior surfaces of the panel shall be painted to an off-white shade.

ENCLOSURE

The panel enclosure shall be totally dust and vermin proof and shall be suitable for indoor installation. All the cubical will be adopted with front located, outward openings, lockable doors having hidden hinges and a bolted back cover both using no deteriorating neoprene rubber gasket. Enclosure design shall be in accordance with degree of protection IP 55 for outdoor and IP-43 for Indoor application. All the nut bolts handle, meters, knobs etc. appearing from outside of the panel should be located in symmetry so as to give a neat appearance.

NAME PLATE

The panel as well as the feeder compartment doors shall be provided with name plate giving the switchboard/feeder descriptions as indicated on the drawings. The above shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door.

TESTING

The power control centers shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS: 3659.

Insulation Test

Insulation of the main circuit, i.e. the insulation resistance of each pole to the earth and that between the poles shall be measured.

Insulation resistance to earth of all secondary wiring should be tested with 1000 Volt megger. Insulation test shall be carried out both before and after high Voltage test. High Voltage Test A high Voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked in position and the breakers closed. Original test certificate shall be submitted along with panel.

STORING, ERECTION AND COMMISSIONING

The panels shall be stored in a well-ventilated, dry place, with suitable polythene covers shall be provided for necessary protection against moisture.

Erection

Switch boards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and leveled. Suitable grouting holes shall be provided in the foundation. Suitable MS base channel shall be embedded in foundation on which the panel can be directly installed. The switch boards shall be properly aligned and bolted to the foundation by at least four bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using high quality brass compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. The switchboard earth bus shall be connected to the local earth grid.

Pre-commission Tests

Panels shall be commissioned only after the successful completion of the following tests. The tests shall be carried in the presence of Developer/Consultant or their representatives. All main and auxiliary bus bar connections shall be checked and tightened.

All wiring termination and bus bar joints shall be checked and tightened. Wiring shall be checked to ensure that it is according to the drawing.

All wiring shall be tested for insulation resistance by a 1000 Volts magger. Phase rotation tests shall be conducted

Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order.

All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an Ammeter in the circuit.

METERING, INSTRUMENTATION AND PROTECTION.

Ratings, type and quantity of meters, instruments and protective devices shall be as per Bill of Quantities.

CURRENT TRANSFORMER: -

CTs shall conform to latest IS codes in all respects. All CTs used for medium Voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be 0.5 to 1 and for protection PS class CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults. Terminals of CTs shall be paired permanently for easy identification of poles. CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated Voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper

termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

POTENTIAL TRANSFORMER

PTs shall conform to latest amendment upto to date IS Codes.

Measuring Instruments

Direct reading electrical instruments shall conform to latest IS codes in all respects. Accuracy of direct reading shall be 1.0 of Voltmeter and 1.5 for Ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -100C and +5000C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in color and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Selector switches shall be provided for Ammeters and Volt meters used in three phase system.

AIR CIRCUIT BREAKER (ACB) FOR ALL PANELS GENERAL:

ACB shall comply with standards IS/IEC 60947-1 & 2.

ACB shall have a rated operational voltage of 415V AC, rated insulation voltage of 1000 volts AC, rated impulse voltage of 8-12kV.

ACB shall be of 3pole or 4pole, air brake, molded case design for longer life along with less maintenance requirement. All LT BREAKER 630 Amp.or more will be ACB .

All ACBs shall preferably be of single frame size up to 2000A to optimize requirement for spares management.

ACB shall have a Ready to close mechanism preferably having a ready to close mechanical indication on front of ACB.

All ACBs will be EDO type and ready to close indication contact which shall be used to give a single indication via indicating lamps on panel door if ACB is ready to be closed, 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.

ACB shall comply with the environmental directives like RoHS.

PERFORMANCE:

ACB shall have the breaking performance $I_{cs} = I_{cu} = I_{cw} (1\text{sec}) = 50\text{kA}$ or calculated ACB shall have minimum Mechanical life of 20000 operations

The operating mechanism of ACB shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 70ms, and of fast opening type with break time of breaker should be <30ms to ensure higher life of distribution cables.

ACCESSORIES & AUXILIARIES:

Shunt trip and closing coil (having common AC/DC supply upto 250V) shall be continuous rated. For Incomer ACBs delayed type under voltage release shall be used to avoid nuisance tripping during voltage surges.

ACBs shall have minimum 4 change-over auxiliary contacts, available to be used for indication and interlocking, rated at minimum 10A 240/380V 50 Hz and shall be wired on chassis/cradle. There should be facility to add one more set of 4 contacts if required

Pre wired Fault trip contact should be provided with Release as standard.

Indication lamps to be provided on front door of ACB feeder shall be as shown below: - Spring charge indication required for EDO ACB only.

SAFETY:

Draw-out ACBs shall preferably be provided with a mechanical latch on chassis which latches the ACB at Connected-Test-Disconnected positions while racking in and racking out the circuit breaker. This feature will help the operator in placing the circuit breaker at right position inside the chassis and can help in avoiding the accident.

The racking handle of the breaker shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

TERMINATIONS:

All air circuit breakers shall be fully tropicalized as standard & suitable for terminating copper or aluminium bus bars. Both fixed & draw-out circuit breakers shall have single pole-pitch. ACBs up to 3200A shall be provided with top horizontal and bottom vertical terminal adapters on both sides for proper cable connections/bus duct connections. Terminal orientation for top and bottom side shall preferably be possible to be changed from vertical to horizontal or vice versa on site as per cable/bus duct entry. Rest of the ACBs shall have both side vertical terminal adaptors for better heat dissipation.

PROTECTIONS:

Air circuit breaker shall be provided with microprocessor release, which should be self-powered type without the need of any auxiliary power supply during normal operation of the breaker.

The circuit breaker control unit shall measure the true r.m.s value of the current circuit breaker trip unit shall have a display for measurement of current and voltage. It shall be possible to view last 5 trip cause on trip unit.

All trip units provided shall have thermal memory as standard All trip units shall be EMC/EMI tested

The protection release shall have following protections as standard: -

Adjustable over load current (I_r) settings from 40% to 100% of rating of ACB (I_n). Over load time setting (t_r) from 0.5s, 1s, 2s, 4s.....24s as field selectable curves.

Short circuit setting (I_{sd}) from 1.5 to 10 times of I_r setting, short circuit time delay adjustable from 0 to 400 msec.

Instantaneous (I_i) protection with an adjustable pick-up and an OFF position.

Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400ms.

Separately powered / Self 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.

I2t ON / I2t OFF options shall be available for short-circuit & earth fault protections which can be used to ensure discrimination with upstream circuit breaker or fuse.

The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.

It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the settings.

All ACBs in main LT panel shall surely be provided with zone selective interlocking which helps in reducing the thermal and dynamic stress on installation during short circuit and ground faults. The releases shall be suitable to communicate between incomer breaker and outgoing breakers enabling zone selective interlocking. The manufacturer shall supply all equipment like ZSI module, power supply and wiring connectors to implement ZSI.

It shall be possible to view the percentage loading of three phases at once on trip unit via LEDs or LCD display to help the user in identifying the current load balancing of the network. This will help in preventing the deterioration of loads affected by load balancing by identification of the balancing related issue.

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 $0.5I_n$ and neutral protection at $1.0I_n$ to ensure precise neutral protection.

MOULDED CASE CIRCUIT BREAKER (MCCB) (FOR PANELS) GENERAL:

MCCBs shall comply with standards IS/IEC 60947-1 & 2. The breaking capacity performance certificates shall be available for category A to the above-mentioned standards.

MCCB shall have a rated operational voltage (U_e) of 415V, insulation voltage (U_i) of 690 V (AC 50/60 Hz) & impulse voltage (U_{imp}) of not less than 8kV.

MCCBs shall be current limiting type preferably having double make & break design having two fixed contacts, one moving contact and two arc chutes per pole. The design is required to minimize the effects of short circuit currents i.e. limit the let through energy and improve the life of cables.

MCCB shall not have any line load bias

MCCB shall comply with the environmental directives like RoHS or WEEE

250A and above rating MCCBs - shall be microprocessor based, category A Or B type (drawout design in main panel and fixed type in sub panels) having $I_{cs} = 100\%$ Of I_{cw} (1sec) not less than 36kA. Microprocessor trip unit shall measure current and voltage data with last 5 trip records. Microprocessor based MCCBs in main panel shall have zone selective interlocking feature. Mechanical life shall be 10000 operations.


PERFORMANCE:

The MCCBs shall have a rated service breaking capacity (I_{cs}) equal to the ultimate breaking capacity (I_{cu}) at 415V and as per system fault levels (refer SLD).

The limiting capacity of a circuit breaker is expressed by two curves which are a function of the prospective short-circuit current (the current which would flow if no protection devices were installed): The thermal stress (A^2s), i.e. the energy dissipated by MCCB during fault should be as low as possible. Cable selection to be done as per Maximum permissible cable

stresses for which manufacture should produce current limiting and energy limiting curves of MCCB's.

SAFETY:

For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries (ON/OFF/Trip Contact, Shunt, Under Voltage etc.). All poles shall operate simultaneously for circuit breaker opening, closing and tripping. MCCBs shall be actuated by a toggle or rotary-handle that clearly indicates the three distinctive positions: ON, OFF and TRIPPED. MCCB shall clearly indicate the suitability for isolation in the name plate identified by the symbol 

MCCBs shall be equipped with a "push to trip" button in front to test operation and simultaneous opening of all poles together.

MCCBs shall be designed to prevent access to live parts when the cover is removed, means main current path of the circuit breaker should be isolated from auxiliary section i.e. MCCB shall offer class –II front face as per IEC standards 61140 and 60664-1

The electrical life of MCCBs shall be 8,000 operations up to 250A & 4000 operations up to 630A.

All MCCBs shall have cross bolted or OEM recommended equivalent type termination where bus bars or cable lugs can be terminated by crossing the bolt between the lugs/bus bars and MCCB connections, to enhance safety and reliability of the terminations. In case spreaders/rear connectors are used in between MCCB and bus bar/lugs then the spreaders shall be cross bolted or equivalent with the MCCB connectors.

AUXILIARIES AND ACCESSORIES:

Following separate Field installable auxiliary contacts for signaling different functions shall be provided with all MCCBs

open/closed position contact trip signaling contact

Electrical fault trip signaling contact

Rotary handle shall ensure IP40 for direct type and IP 54 for extended Rotary handle.

MCCB shall have provision for Rear connection - MCCB mounting on a back plate with suitable holes enables rear connection. The rear connections are simply fitted to the device connection terminals.

PROTECTIONS REQUIREMENTS:

MCCBs shall have microprocessor trip units.

Thermal magnetic trip units shall have variable overload settings from 0.8 to 1 Ir and fixed short circuit settings

Microprocessor trip units shall have variable overload settings from 0.5 to 1 Ir and variable short circuit settings from 2 to 10Ir

In case of 4 pole microprocessor inbuilt earth fault based MCCBs neutral shall be protected & adjustable as a Neutral unprotected / Neutral protected at 0.5 In/ Neutral protected at In.

MCCB's should be provided with auxiliary contacts for signaling different functions, as: open/closed position, fault signal and shunt trip coil for remote/emergency tripping of MCCB.

Where ever it is required based on electrical distribution network need, MCCB shall have Earth Fault Protection as a provision. MCCB Earth Fault Protection should have following settings and features:

Selection of Ir MCCB rating

Earth fault sensitivity selection from 20% – 60% In.

The time delay selection in case of Earth Fault from 0.5 to 3 Sec/ instantaneous.

There shall be a separate fault differentiation indication (LED) for Over current and Earth fault. Indication for over current and earth fault tripping shall be extended to the panel door via indication lamps

Separate LED shall be there to show healthiness of earth fault protection system

EF protection module shall be suitable for 3P 4W system. It shall take the input from neutral for correct earth fault protection.

Earth fault module shall have auxiliary contacts for earth fault signaling.

BUS DUCTS (SANDWICHED CONSTRUCTION) SCOPE:

The specification covers design, manufacturing, supply, installation, testing and commissioning of Sandwich type bus bar trunking for use as feeder bus bars for interconnection between separate electrical equipment/ load centers, and for use as plug in bus bar risers and it should be suitable for 1000 Meter MSL.

GENERAL:

Bus bar Trunking shall be sandwiching type construction. It shall be 3 Phase with 100% Neutral and PE conductor enclosed in GI / all sheet steel (CRCA) housing.

Bus bar Trunking shall be rated for operational voltage of 690V with insulation voltage of 1000V, Rated Impulse Voltage withstand-8Kv and shall be suitable for 50Hz frequency.

Sandwich type bus bar shall be suitable for distribution application from 400A to 4000A copper/Al conductor. From transformer to main LT Panel, DG Panel to Emergency Panel & Main LT Panel to APFC Panel sandwich Bus Duct will be provided.

Range shall be suitable for horizontal and riser application and should be complete with feeder/plug in and all accessories like expansion joints, reducers, end terminal covers etc. as recommended by the manufacturers. Standard length of bus bar shall not be less than 3000mm & plug in opening shall be provided at regular intervals with safety shutters. Special length shall be designed to connect the end piece and some special requirements.

The Plug in Busway shall be suitable for vertical and/or horizontal installation.

All indoor application shall use IP54 and for outdoor application IP65 with canopy should be used.

Busduct /Rising Main shall have mounting Brackets welded to the housing of Bus duct/Rising Main for Installation of External earth Busbar on both the size, the earthing Contractor shall be Installed in the rising main with proper Hardware and star washer so that paint on bracket is peeled off and proper contact of earthing bus bar is insured with housing of rising mains.

SHORT CIRCUIT AND TYPE TEST:

Bus way system shall comply with following standards: IEC 61439-1&6

All type test certificates according to above standards shall be of International Lab of repute such as CPRI/DEKRA/LOVAG /KEMA or equivalent.

Type test certificate shall be produced for validation before ordering for Rated Short Circuit breaking capacity for 1sec.

Type Test certificates confirming Mechanical Operation and Temp. Rise of Tap Off Box of similar design in accordance with IEC-61439 are must.

Busway manufacturer shall produce a Type Test 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.

The type test for IEC-60068 of seismic certificate of green premium product from independent test house is a must.

HOUSING:

The bus bar trunking housing shall be constructed of 1.6 mm thick (sheet steel, CRCA housing), IK-10 on all the sides. It shall be provided with a suitable protective finish of epoxy resin paints.

Housing shall be light in weight for ease of installation and maintenance.

The bus bar trunking housing shall be totally enclosed non-ventilated, for protection against mechanical damage and dust accumulation.

Modifications of bus bar trunking to make it totally enclosed by other than the bus bar trunking manufacturer voids the manufacturer's warranty.

For outdoor/Higher IP protection the housing made by the manufacturer shall be considered based on adequate type test reports ratifying their use in desired conditions/locations alongside a confirmation meeting the requirement of basic IP Protection sought above.

Housing shall be non-corrosive and shall be able to withstand 1000 hours of salt spray test.

Enclosure Temperature shall not increase more than 50 degree and Temperature rise should be 45 degree.

BUS BARS:

Bus bar conductors shall be high conductivity Aluminium Alloy.

Each bus bar shall be individually insulated Class F (155 Deg C) insulation with multilayer of reputed make UL certified insulation insulating film (Certified Insulation Material as per standards), epoxy or mica insulation not allowed.

Both feeder and plug-in bus bar trunking for all ratings shall be of sandwich construction, with no air gap between bus bars except at plug-in openings.

NEUTRAL BUS BAR:

Internal neutral conductor shall be 100%, which can meet with the requirements of various power systems in the installations.

PLUG IN OPENINGS:

On plug-in bus bar trunking there shall be three dead front, hinged cover type plug-in openings on each side of standard three-meter lengths.

All openings shall be usable simultaneously.

All contact on joint and plug-in opening should be silver plated copper.

It shall be possible to inspect the plug-in opening and bus bars prior to the installation of the plug-in unit.

PLUG-IN UNITS:

Plug-in Units circuit breaker type shall be operated with visible rotary quick make and quick-break mechanism.

All plug-in units shall have MCCBs of suitable breaking capacity as per design. MCCB and bus bar system shall be of same manufacturer. It should also be type tested as per IEC 61439-1&6.

PLUG-IN UNIT SAFETY DEVICES:

Plug-in unit enclosures shall make positive earth connection with the earth bus before the jaws make contact with the phase bars.

The Earthing method shall be such that it cuts through painted surfaces to make the positive earth connection.

Plug in box unit shall have an protection of IP 54 along with the housing so that there is no access to live bus bars once connected.

The plug is provided with internal interlocking mechanism to prevent the plug door being opened whilst energized, ensuring operational safety.

Plug in Boxes shall be suitably Type Tested / as per IEC 61439.

JOINT:

The bus bar trunking joint shall be of the on-bolt type which utilizes a high strength steel bolt(s) and washers to maintain proper pressure over a large contact surface area.

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.

Access shall be required to only one side of the bus bar trunking for tightening joint bolts.

On bus bar trunking, it shall be possible to remove any joint connection assembly to allow electrical isolation or physical removal of a bus bar trunking length without disturbing adjacent bus bar trunking lengths.

SUPPORT OF BUS BAR TRUNKING:

Hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations.

Indoor Feeder and plug-in bus bar trunking shall be approved for hanger spacing of up to two meters' for horizontally mounted runs and four meters' for vertically mounted runs. Outdoor feeder bus bar trunking shall be approved for spacing of up to 1.2 meters' for horizontally or vertically mounted runs.

VOLTAGE DROP:

The voltage drop (input voltage minus output voltage) specified shall be based on the bus bar trunking operating at full rated current and at stabilized operating temperature.

INSTALLATION:

The bus bar trunking construction should be such that no two consecutive pieces be installed as successive TOP and BOTTOM, i.e., there should be a clear mechanical preventer to prevent installation of (TOP) RYBN and (BOTTOM) NBYR.

HYBRID POWER FACTOR CORRECTION PANEL (minimum as per Ghira - 3) SCOPE

Real time Hybrid Type Automatic power factor control panels (as per the IEC 61921) with ultra-heavy-duty capacitors, IGBT switched, Active harmonic filters (AHF) (minimum 25% of total capacitor reactor) & coupled with Detuned Reactors are proposed to be provided in the substations to achieve overall power factor between 0.97 to unity (lagging) from existing Power Factor, as per ECBC with operation in both Auto and Manual mode. Power factor Correction Panel shall be BMS Compatible. Multiple capacitor units with real time automatic power factor compensating relay panel shall be provided. The capacitor panels with Hybrid Harmonic filters shall be provided in each substation to achieve THD less than 3%. Connection from Main LT Panel to Capacitor Panel is to be provided through Aluminum XLPE cable. Automatic switching off of Capacitor Panel is to be considered during Power supply availability from DG.

ENCLOSURE

The panel shall be indoor type, free standing, and floor mounting with IP43 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 color shade/s to match the color 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:

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

APFC PANEL OPERATION:

The APFC panel shall, in its default configuration, shall implement the following features through an integrated controller. The integrated 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 stepless 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:

Step-less Power Factor Correction (for both leading and lagging current), Control response time: 25-100 μ s

Harmonics Compensation up to 51st order (2nd priority) Load Current Balancing in the three phases (3rd priority) **APFC PANEL SHALL COMPRISE:**

Incomer

A suitably sized as indicated in Four pole MCCB or ACB having microprocessor based over-current and short-circuit protection and at least 50Ka OR calculated breaking capacity (100% Ics) as the incomer of the panel.

Metering and Indication

R, Y, B indication lights for the incomer ACB / MCCB

On, Off & Trip indication lights for the incomer ACB / MCCB

A digital multifunction meter showing voltage, current, frequency, PF, THD, kW, kVA, and other related parameters

Three number of cast resin CTs of suitable rating

One number of three phase digital ammeter showing current in three phases of APFC 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 APFC panel. In this case, we have required a minimum capacity of IGBT based active power filter and suitable capacity 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.

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.

The active filter shall be suitable for connection at an electrical distribution panel, transformer secondary or at an individual load.

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.

The active filter shall be suitable for operation on an electrical system having a generator as its power source.

AHF should have high attenuation greater than 97% of individual harmonics

AHF shall allow selection of any 20 order of harmonics out off 2nd to 51st harmonics order.

It should be possible to use filter for single harmonic elimination

PF compensation should be leading as well as lagging APF should be capable of unbalance correction

ESSENTIAL REQUIREMENTS FOR THE POINT OF RELIABILITY

For capacities above 200 Amp onwards the filter design should adapt modular construction

The display should be Touch screen SVGA display with true RMS values. The wave form should be visible on the display.

High grade cooling blowers shall be used.

In case of future repair requirements, the same shall be done through card level replacement and not the whole module

ELECTRICAL RATINGS:

System Voltage: 400V AC $\pm 10\%$, 3ph 4 Wire/3 wire Line voltage tolerance: $\pm 10\%$

System Frequency: 50 Hz Frequency tolerance: 50 Hz $\pm 5\%$

Harmonic Cancellation Current: [30, 60, 75, 100, 150, 200, 300, 400, 600 amps]. Multiple filter units for parallel connection may be used to achieve total current requirements for combined power factor correction and harmonic mitigation.

Possible units of same ratings connected in parallel: Infinite.

Current transformers shall be with Class 0.5 or better with 15VA rating. Flexibility to select CT ratio shall be also be available.

Surge withstand capability per ANSI/IEEE STD C62.41-1991. Should comply with IEC/IEEE 62040 – 2 category C3.

The Active harmonic filter shall be of certified design confirming to IEC 60529, CE

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

61000-6-2, Seismic rating: Complies with IBC and ASCE7

BASIC PRODUCT REQUIREMENTS

The active harmonic filter shall meet the following basic requirements: Active filters shall include input surge suppression.

Active filters shall include forced air-cooling system.

Active filter shall be able to connect in both open loop and closed loop configuration

Active filter should have a HMI touch screen display having the functionality of a power analyzer and should display parameters as mentioned below:

Current Parameters: Arms, A1rms, iTHD (%), Aunb

Voltage Parameters: Vrms, V1rms, Urms, vTHD (%), Vunb, Frequency Power Parameters:

Active, Reactive, Apparent Power

Power Factor Displacement Power Factor

Filter Parameters: Apk, Filter Utilization, Stack Temperature, DC Voltage, Filter Runtime, Fan Runtime, Panel Temperature

Voltage and current waveforms

Voltage and current Harmonic spectrum Alarm indications & log details

Product warranty period shall be one (1) year.

Active filter shall be isolated from the power supply when powered “off”.

IGBT modules shall be self-protected for maximum reliability.

The response time shall be at least 25µs and the correction time shall be less than 10 ms

AHF shall have auto fold back feature.

Construction:

Constructed on metal panel with minimum IP 43.

Filter shall be suitable for operation upto an ambient temperature 45oC with suitable ventilation and shall give an alarm signal in case of temperature going beyond a set limit.

Shall be able to work with higher temperature with automatic de-rating (80% capacity at 50oC)

Storage temperature shall be from 0oC to 70oC with suitable packing

Active filters shall be suitable for operation in relative humidity up to 95% non-condensing.

Panel shall have an audible noise level lesser than 65db

Panel shall have a filtering efficiency of at least 97%

Panel shall have a reaction time of at least 25 micro-seconds Power factor correction shall always be set at priority

Priority selection between the remainder features - harmonics compensation and load balancing - shall be programmable at the time of commissioning. In the default mode, harmonics compensation is set at 2nd priority and load balancing is set at 3rd priority

Auto fold-back of the APFC panel if total current requirement exceeds the rated capacity of the panel

All live parts of the system shall be properly shrouded

Inspection terminal strip, number ferruling, and other labeling shall be suitably provided

Stickers marked with “DANGER” shall be provided wherever required Detailed drawings and manuals shall be provided wherever required Following protections shall be provided:

Over voltage (AC) protection Over voltage (DC) protection Phase sequence protection Over current protection Over temperature protection

Protection circuits for the inverter stack and its components

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 color 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.

CAPACITOR BANK

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 phases, delta connected, 50 Hz.

Voltage: Must be designed to withstand system over voltage, increased voltage due to series reactor and harmonics.

Capacitor type: Super heavy duty with double side metalized capacitor tissue paper. Oil impregnated and self-healing type with bi-axially oriented polypropylene film shall be 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: $2.5 \times I_n$

Peak Inrush current withstands: $(350) \times I_n$

Total watt-losses including discharge resistors: $<0.45 \text{ W} / \text{k V Ar}$. Temperature category: -25 deg.C to 65 deg.C.

Capacitor shall be self-healing type and oil 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 43 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 Disconnect 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% reactor** shall be used with harmonic filter duty power capacitors to mitigate harmonics, improve power factor and avoid electrical resonance in LV electrical networks. 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 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

ENERGY METERS. FOR HT INCOMERS

Power Quality Analyzer - High end power quality analyzer with Class 0.2 active energy Accuracy with Sag/Swell - Waveform capture and Individual harmonics monitoring upto 63rd. Power Quality analyzer needs to be capable of Disturbance direction detection with onboard dual ethernet Port communication.

Basic Parameters	Current, voltage, frequency Active, reactive, apparent power Total and per phase Power factor Total and per phase Current measurement range (auto ranging) 0.05 - 10A
Energy Parameters	Active, reactive, apparent energy Settable accumulation modes
Demand Parameters	Current Present and max. values Active, reactive, apparent power - Present and max values Predicted active, reactive, apparent power Synchronization of the measurement window Setting of calculation mode - Block/ sliding
Power Quality Parameters	Total Harmonic Distortion Current and voltage Individual harmonics - Upto 63rd Waveform capture Detection of voltage swells and sags Disturbance Direction detection
Sampling Rate / Cycle	Minimum 256 Samples/ Cycle
Data Recording	512MB of standard non-volatile memory. 10 MB of standard non-volatile memory dedicated to capture billing data, events, and waveforms. Logs of Min/max of instantaneous values, Event logs, Trending/ forecasting, SER (Sequence of event recording).
Class Accuracy	Active Energy - Class 0.2S IEC 62053-22, Reactive Energy Class - 0.5S IEC 62053-24, Power Factor - Class 0.5 as per IEC 61557-12
PQ Standards	PQ compliance reporting as per IEC 61000-4-30 Class S, - IEC 62586 PQI-S
Communication	Onboard Dual ethernet port for daisy chaining over ethernet. Meters need to have Modbus Mastering capability by connecting Slave devices over RS485 port
Time Synchronization	GPS clock (RS485) or IRIG-B (digital input) to +/- 1 millisecond.
Digital IO	Standard: 3 digital status inputs for Breaker ON/OFF/Trip monitoring & 1 KY (form A) energy pulse output for interfacing with other systems. Expandable DI/DO, ADI/ADO capability
Display	Bright LCD colour display with meter dimension 96 X 96 mm only

FOR LT PANEL AND OTHERS

Multifunction Meter - Multifunction meters with Power and harmonics monitoring capturing abnormalities in the system with date and time stamp	
Basic Parameters	Current - Average line current of 3-phase, per-phase, and calculated neutral current Voltage Average voltage of L-L, L-N parameters, and per phase Frequency Displacement power factor Average and per-phase signed True power factor Average and per-phase signed % unbalance among the phase for L-V L-N, V L-L
Energy & Power Parameters	Real, reactive, and apparent power Total and per-phase value Accumulated Active, Reactive and Apparent Energy Received and Delivered registers, Net and absolute energy values, time counters
Demand Parameters	Current average, Active power, Reactive power, Apparent power - Present, Last, Predicted, Peak, and Peak Date Time Demand sync methods Thermal, Timed, Command Sync and Clocked Sync Demand calculation mode Sliding, fixed and rolling block Demand intervals - settable from 1 to 60 minutes
Power Quality Parameters	THD as per IEC 61557-12 for THD and individual harmonics up to 15th over communication
Sampling Rate / Cycle	Minimum 64 Samples / Cycle
Class Accuracy	Active energy - Class 0.5S as per IEC 62053-22
Communication	RS 485 port Modbus RTU and disabling RS485 port against unauthorized access.
Calibration LED	configurable from 1 to 9999000 pulses/k_h (kWh, kVAh or kVARh)
Min/Max values	instantaneous parameters with timestamp
Display	Bright red colour LED display with meter dimension 96 X 96 mm only

HVAC WORK

SPECIFICATION

1. The system shall be VRF (Variable Refrigerant Flow) system. The system shall adopt the inverter technology for energy saving and shall use R410A Eco-friendly refrigerant for green environment and shall connect multiple indoor units for independent operation with long piping / high elevation / big capacity. The system shall be able to operate at cooling as well as heating mode. Outdoor unit shall operate continuously without tripping up to 53 deg. C DBT in cooling mode. The outdoor unit shall have a powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. Outdoor unit shall consist of BLDC inverter scroll compressors (All Inverter), Inverter fan motor, electronic expansion valve, oil separator, and accumulator. Outdoor unit shall have High pressure switch, high pressure sensor, reverse phase protection, Self-diagnosis and Soft start as safety devices or functions. Condenser Fins should be coated with Anti-Corrosive Layer (Epoxy Acrylic coating) in addition to Hydrophilic Coating. The heat pump system should consist of 100% inverter driven advanced flash injection scroll compressor, optimized DSH (Discharge Superheat Control), AI enabled technology, factory fitted microprocessor based self-diagnostic & on device inverter check Should have Minimum EER of 3.6 (at 100% Load) in Cooling Operation. Outdoor unit (individual modules) shall have a sound rating no higher than 67 dB (A) at 1m distance from the front of the unit. The heat pump outdoor unit shall be capable of operating in cooling mode between (-5°C to 53°C) outside ambient temperatures. All fan motors shall be **variable speed BLDC** type. Condenser Fins should be coated with Anti-Corrosive Layer (Epoxy Acrylic coating) in addition to Hydrophilic Coating. All compressors shall be modulation capable, flash injected, DC inverter, scroll type. The compressors shall have flash injection capability to increase performance in heating mode. This will be automatically enabled by the outdoor unit(s) by forcing saturated refrigerant as a liquid flash mix directly into the scroll compression cycle increasing mass flow and overall system capacity. Compressors without flash injection shall not be present in the VRF heat pump system. Indoor Units (wind free) with long life washable filters, PCBs and comprising of compact cooling coil, electronic expansion valve, multi speed fan motors, dynamically balanced blowers, NRV (Non Return Valve) fitted built in drain pump with electronic level sensor, Wi-fi enabled, suitable for remote control operation suitable to operate from central remote control, an installation from ceiling with all required support, anchor fasteners hardware, interconnecting refrigerant copper piping, valves, supports etc

LIFT WORK

SPECIFICATION

General specifications for lift work shall be as follows:

- All Lift shall be MR (Machine room) type.
- Regenerative drive included to save power consumption upto 30%
- VVVF Drive with VF Door Operation
- Permanent Magnet Gearless Motor (PM)_Motor Dual Disc Brake
- Automatic operation for car fan
- All Panels SS Hairline-304 Grade
- ARD working in Single Phase
- 3-Way Intercom
- GRANITE Flooring
- Scaffolding by SIPL for Lift Installation
- Handrail Rear side
- Provision For CCTV
- Car arrival Chime
- 2 Hour Fire rated doors (EN 81-58 E120)
- Alarm by horn in hoistway
- Automatic Return to main floor
- Attendant service (KA/KS)
- Car call cancellation
- Auto.door closing final time
- Travel direction indicator car
- Arrival & further travel Indicator
- Auto. Rescue Device (ARD)
- Fire emergency switch
- Mechanical Push Buttons Half Height
- Braille Buttons
- Controller position in the right door jamb (LDU)
- Adjustable door open time
- Door open and close fixtures in COP
- Emergency Light
- Full load bypass
- Infrared full height door sensor
- Motor Overheat Protection
- Overload function with visual indication in COP

EMERGENCY ESCAPE LIGHTING

Life Safety Code requirements for Emergency Lighting Systems as per EN1838

the emergency lighting system shall be arranged to provide the required illumination automatically in the event of any interruption of normal lighting due to any of the following:

- 1.Failure of a public utility or outside electrical power supply
 2. Opening of a circuit breaker or fuse
 3. Manual act(s), including accidental opening of a switch controlling normal lighting facilities
- Periodic testing
1. Functional testing shall be conducted monthly with a minimum of 3 weeks and a maximum of 5 weeks between tests, for not less than 30 seconds.
 2. Functional testing shall be conducted annually for a minimum of 1 hour if the emergency lighting system is battery powered
 3. Not less than once every 30 days, emergency lighting equipment shall automatically perform a test with duration of a minimum of 30 seconds and a diagnostic routine.
 4. Illumination for signs shall be permitted to flash on and off upon activation of the fire alarm system. Based on the control signal from Fire Alarm System or actuating device, the Exit lights shall flash to draw the attention towards the Escape Route in case of a Zone Fire Alarm or similar situation

Emergency Lighting system is to be provided when the supply to the normal lighting fails & is therefore powered from a source independent of that supplying the normal lighting

The overall objective of the emergency escape lighting is to enable safe exit from a location in an event of failure of the normal supply

The objective of escape route lighting is to enable the safe exit from a location for occupants by providing appropriate visual conditions & direction finding an escape route & in special locations, & to ensure the fire fighting& safety equipment can be readily located & used

Scope

The EN1838 standard specifies the luminous requirements for emergency lighting systems installed in premises or locations where such systems are required. It is principally applicable to locations where the public or workers have access

Normative References

This European standard incorporates the latest edition of standards as: -

EN 60598-2-22 Luminaires – Part 2-22, Particular requirements – Luminaires for Emergency lighting (IEC 60598-2-22: 1997, modified) EN 50172 Emergency Escape Lighting System
Emergency Escape Lighting

General

To provide visibility for evacuation purposes lighting is required in the volume of the space.

In this standard the recommendation is fulfilled by mounting of luminaires atleast 2m above the floor. Signs which are provided at all exits intended to be used in an event of emergency & escape routed should be illuminated to indicate unambiguously the route of an escape to a point of safety

Where direct sight of an emergency exit is not possible, an illuminated directional sign (or series of signs) shall be provided to assist progressive towards the emergency exit

An escape lighting luminaire complying with EN 60598-2-22 shall be sited to provide appropriate illuminance near each exit door & at positions where is necessary to emphasize potential danger or safety equipment. The positions to be emphasized shall include the following: -

- a. At each exit door intended to be used in an emergency
- b. Near stairs, each step of stair receives direct light
- c. Mandatory emergency exits & safety signs
- d. At each change of direction
- e. At each intersection of corridors
- f. Outside & near to each final exit
- g. Near each first aid post
- h. Near each piece of fire fighting equipment & call point

Exit Signage's

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- d. At each change of direction
- e. At each intersection of corridors
- f. Outside & near to each final exit
- g. Near each first aid post
- h. Near each piece of fire fighting equipment & call point

Exit Signage's

The features should include & not limited to

- LED based exit sign with dimming function

- Delivered as self-contained/auto test luminaire
- IP 40 or above – dustproof luminaire
- Reading distance 18-30 meters
- Technical lifetime of LED > 100 000 hours
- Simple and quick assembly and maintenance

Approvals EN60598-1,EN60598-2-22,EN55015,EN 61547,EN 61000-3-2, EN 61000-3-3
Emergency Escape Route Lighting

The features should include & not limited to

- LED based and surface mounted anti-panic lighting
- Delivered as self-contained/auto test luminaire
- Greater spacing with new efficient LED
- High lumen output – 350 lumens
- Simple and quick assembly and maintenance
- Technical lifetime of LED > 100 000 hours

Approvals EN 60598-1, EN 60598-2-22, EN 55015, EN 61547, EN 61000-3-2, EN 61000-3-3

RACEWAY

All raceway shall be of 1.6mm/2.0mm thick G.P.The raceway shall have Z- section, hole with thread for cover screw, coupler plate, cover, junction box, fly cover etc. as required. The screw for cover fixing shall be counter sunk type. The size of raceway shall be as follow.

WIDTH THICKNESS (mm)	WIDTH (mm)	HEIGHT (mm)	THICKNESS (mm)	COVER
50		40	1.6	1.6
75		40	1.6	1.6
100		40	1.6	2.0
150		40	2.0	2.0
200		40	2.0	2.0
300		40	2.0	2.0

SAFETY EQUIPMENTS

DESCRIPTION OF WORK

- Insulation Mats
- First Aid charts and First Aid Box
- Danger Plate
- Fire Extinguishers
- Fire Buckets
- Tool Box

G. Caution Board

H. Key Board

APPLICABLE CODES & STANDARDS

- A. IS : 15652 Insulation mats
- B. IS : 2878 Portable CO₂ Fire Extinguisher
- C. IS : 2546 : Fire Buckets
- D. ANSI/NFPA 70 - National Electrical Code. SUBMITTALS

Product Catalogues. SPECIFICATION INSULATION MATS

Insulation mats conforming to IS: 15652 shall be provided in front of main switch boards and other control equipment as specified.

FIRST AID CHART AND FIRST AID BOX

Charts (one in English, one in Hindi, one in Regional Language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate places. Standard First Aid Boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in sub-station.

DANGER PLATE

Danger plates shall be provided on HV and LV equipments. LV danger notice plate shall be 200 mm x 200 mm made of mild steel atleast 2 mm thick vitreous enamelled white on both sides and with inscriptions in signal red colour on front side as required.

Size of the HV Danger Notice plate shall be 250 mm x 200 mm and 2 mm thick. FIRE EXTINGUISHERS

Portable CO₂ conforming to IS: 2878-1976 dry chemical (conforming to IS 2171-1976) extinguishers shall be installed in the sub-station at suitable places (like HT/LT panel rooms) as specified.

Foam type fire extinguisher shall be installed in Transformer Room.

FIRE BUCKETS

Fire buckets conforming to IS: 2546-1974 shall be installed with the suitable stand for storage of water and sand.

TOOL BOX

A standard tool box containing necessary tools required for operation and maintenance shall be provided in sub-station.

CAUTION BOARD

Necessary number of caution boards such as "Man on Line" "Don't switch on" etc. shall be available in the sub-station.

The Caution Board shall be of size 300 mm x 200mm made of mild steel, 2mm thick, vitreous enamelled white on both sides and with inscriptions in original red colour on front side as required.

KEY BOARD

A key board of required size shall be provided at a proper place containing castel keys, and all other keys of sub-station and allied areas.

The Key board shall be made of 12mm thick first class teak wood shall be of size 400 mm x 300mm and with adequate depth to hold the keys. It shall be provided with a lockable type hinged glass door made of 12 mm. thick first-class teakwood frame with 3 mm thick sheet glass fixed with piano hinges. The key board shall enough number of hooks for hanging the castle keys and all other keys of the sub-station and allied areas. It shall be painted with one coat of wood primer and two coats of white enamel paint.

FIRE SURVIVA CABLE

1, The cable shall confirm to Underwriters Laboratory UL 2196) (Latest Edition). All additional equipment and accessories required for the UL 2196 certification to be met should be supplied by the supplier as per the UL certificate

2, The cable shall have operating voltage grade of 1100V and outer sheath be of copper.
3, The cable shall withstand the test temperature curve per ASTM E119 with a temperature of 1010°C at 2 hours as per UL 2196

4, Regulatory requirements shall be as follows:

A. Fire-Resistance: All products installed in "fire zone" shall be listed as per UL 2196 (US) for fire rating as required in the NEC (US).

B. Flame Propagation: All products installed in "fire zone" shall be FT4 certified.

C. Low Smoke: All products installed in "fire zone" shall be designated "low smoke" according to UL 1685 / ST1, "Smoke Release" test.

D. It Should also Confirm to ANSI/NFPA 70.

5, The cable shall have a warranty of at least 30 years

6, The cables shall be connected to the various devices with proper termination kits/glands. Appropriate glands shall be provided where the cable enters the junction box.

7, Cables are to be supplied along with all accessories, crimped termination etc. Cable is to be laid by the Trained & Experienced personnel only.

8, The cable when running in outdoor area shall not be taken overhead. It shall be laid underground according to IS 1255-1983 (Latest Edition)

9, The manufacturer shall have their proper sales office and well established service center in India at least for last 10 years.

10, The manufacturer shall have their own adequate number of trained personnel, to provide installation and termination training in India..

11. The Bidder should submit an authorization letter from OEM in original for the tender called.

ELECTRICAL WORK

1) SCOPE

This chapter covers the requirements for the electrical works associated with heating, air conditioning, ventilation and cold room applications, namely, switch boards, power cabling, control wiring, earthing, p.f. capacitors and remote control-cum-indicating panels. Electric motors are not covered here, as these are covered as part of the respective equipment specifications.

2) GENERAL

Unless otherwise specified in the tender specifications, all equipments and materials for electrical works shall be suitable for continuous operations on 415 V / 240 V + 10% (3 phase/single phase), 50 Hz. AC system. Where the use of high voltage equipments is specified in particular works, all the respective equipments shall be suitable for continuous operation on such specified high voltage.

All electrical works shall be carried out complying with the Indian Electricity Rules, 1956 as amended to date.

All parts of electrical works shall be carried out as per appropriate CPWD General specifications for Electrical works, namely, Part I (Internal) 2013, Part II (External) 1994 work, and Part IV (Sub-station), 2013 all as amended to date.

All materials and components used shall conform to the relevant IS specifications amended to date.

3) SWITCH BOARDS

The main switch board in the A.C. plant room shall be floor mounted, free standing cubical type and shall be factory built fabricated by one of the reputed switch board manufacturer. It shall be suitable for termination of the incoming cable(s)/ bus trunking from top/ bottom. The switchboards in air handling unit (AHU) rooms shall be wall mounted, or floor mounted as feasible at site and as approved by the Engineer-in-charge, but they shall be cubical design, unless otherwise specified and open able from front.

The capacity of switch gear, starters etc. shall be suitable for the requirements of loads fed/controlled. Starting currents shall be duly considered in case of motor loads.

Switch fuse units shall be used upto and including 63 A and fuse switch units shall be used for 100 A and above. ACB shall be used for 630 A and above ratings.

All switch fuses/fuse switches dis-connector switches shall be of AC 23 duty as per IS: 4064-1978 as amended upto date. They shall be complete with suitable HRC cartridge type fuses.

Switch boards controlling motors shall house starters for motors, unless otherwise specified. Independent single phasing preventers for each such starter shall be provided. The starter and SPP shall be located adjacent to the controlling switch gear.

One volt meter with selector switch, a set of indicating lamps and fuses for voltmeter and lamps shall be provided at each switchboard. One ammeter with CTS, and selector switch shall be provided with each motor starter. Instruments shall be flush mounted with the panel and have a glass index not higher than 1.5. The instruments and accessories shall be provided whether or not specifically indicated in the tender specifications.

The fabrication of switchboard shall be taken up only after the drawings for the fabrication of the same are approved by the Engineer-in-charge.

Switchboards shall be fabricated as per specifications indicated in sub- para above.

The layout of bus bars and cable alleys shall be designed for convenient connections and inter-connections with the various switchgear. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming

necessary on a defective circuit.

Care shall be taken to provide adequate clearances between phase bus bars as well as between phase bus bars, neutral and earth.

Where terminations are done on the bus bars by drilling holes therein, extra cross section shall be provided for the bus bars. Alternatively, terminations may be made by clamping.

Provision shall be made for proper termination of cables at the switchboards such that there is no strain either on the cables, or on the terminators. Cables connected to the upper tiers shall be duly clamped within the switchboard.

Identification labels shall be provided against each switchgear and starter compartment, using plastic engraved labels.

Metallic danger board conforming to relevant IS shall be fixed on each electrical switchboard.

Switchboard housing only isolators near cooling towers shall be housed in weather proof enclosure. The mounting arrangement shall be as approved by the Engineer-in-Charge to suit the site conditions.

4) POWER CABLING

Unless otherwise specified, the power cables shall be XLPE insulated, PVC outer sheathed aluminium conductor, armoured cables rated for 1100 V grade. The power cables shall be of 2 cores for single phase, 4 cores for sizes upto and including 25 sq.mm, 3-1/2 core for sizes higher than 25 sq.mm for 3 phases. Where high voltage equipments are to be fed, the cables shall be rated for continuous operation at the voltages to suit the same.

Power cables shall be of sizes as indicated in the tender specifications. In all other cases, the sizes shall be as approved by the Engineer-in-Charge, after taking into consideration the load, the length of cabling and the type of load.

Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls, or laid directly in ground or clamped on structures, as may be required. Cable ducts shall not be provided in plant rooms. Cable trays shall be fabricated from slotted angle/solid angles to make ladder type cable tray, designed with adequate dimensions for proper heat dissipation and also access to the cables. Alternatively, cable trays may be of steel sheet with adequate structural strength and rigidity, with necessary ventilation holes therein. In both the cases, necessary supports and suspenders shall be provided by the Air-conditioning Contractor as required.

Cable laying work shall be carried out in accordance with 13.4 (iii) above. The scope of work for the Air-conditioning Contractor shall include making trenches in ground and refilling as required, but excludes any masonry trenches for the cable work.

5) CONTROL WIRING

Control wiring in the plant rooms and AHU rooms shall be done using ISI marked PVC insulated and PVC sheathed, 1.5 sq.mm copper conductor, 250 V grade, cables drawn in ISI marked steel or PVC Heavy Grade conduits. Alternatively, armoured multi-core copper conductor cables may also be used for the purpose. The control cables interconnecting the plant room and the AHU rooms shall be of multi-core armoured type only, and suitable for laying direct in ground.

The number and size of the control cables shall be such as to suit the control system design adopted by the Air-conditioning Contractor.

ISI marked steel conduit pipes, wherever used, shall be of gauge not less than 1.6 mm thick (MS) & 2.0 mm thick (PVC) for conduits upto 32 mm dia and not less than

2.0 mm thick for higher sizes. All conduit accessories shall be threaded type with substantial wall thickness. Control cables shall be of adequate cross section to restrict the voltage drop.

In the case of control wires drawn through steel conduits, the wire drawing capacity of conduits as

specified under the CPWD General Specifications for Electrical Works (Part I) 1994 shall not be exceeded.

Runs of control wires within the switchboard shall be neatly bunched and suitably supported/clamped. Means shall be provided for easy identification of the control wires.

Control wiring shall correspond to the circuitry/sequence of operations and interlocks approved by Engineer-in-Charge.

In cold storage involving temperatures below zero deg. C, polythene cables shall be used instead of PVC cables.

6) EARTHING

Provision of earth electrodes and the type of earthing shall be as specified in the tender specifications.

The earth work shall be carried out in conformity with CPWD Specifications for Electrical works (Part-I), Internal 1994.

Metallic body of all medium voltage equipments and switch boards shall be connected by separate and distinct earth conductors to the earth stations of the installations; looping of such body earth conductors is acceptable from one equipment, or switch board to another.

G.I. plate earthing shall be provided for PTAC plants and reciprocating central AC plants upto 100 TR capacity. Above 100 TR reciprocating units and centrifugal/ screw chilling units copper plate earthing shall be provided.

The size of earth conductors for body earthing of equipments shall be as under:

Motors upto and including 10 HP rating: 2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire

12.5 HP to 40 HP: 2 Nos. 4 mm dia copper wire/ 2 nos. 6mm dia GI wire

50 HP to 75 HP: 2 Nos. 6 mm dia copper wire/ 2 nos. 25x3mm GI strip

Above 75 HP: 2Nos. 25mm x 3mm copper strip/ 2 nos. 25x6mm GI strip

Switch boards with incoming rating

Upto 100 A: 2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire

125 A to 200 A rating: 2 Nos. 6mm dia copper wire/ 2 nos. 25x3mm GI strip

Above 200 A rating: 2 Nos. 25mm x 3mm copper strip/ 2 nos. 25x6 mm GI strip

Armouring of cables shall be connected to the body of the equipments/switch board at both the ends. Compression type glands shall be used for all such terminations in the case of PVC cables.

7) POWER FACTOR CAPACITORS

PF capacitors shall be provided for all motor loads of 5 HP and above. These capacitors shall come into circuit when the respective motor load is switched on. For this purpose, necessary interconnections between the capacitors and the motors/starters shall be included in the scope of work of the Air-conditioning Contractor.

The power capacitors shall be of such value as to improve the PF to

0.90 lagging when the motor is running at full load. In the case of large size motors, the capacitors may be made in suitable banks so that the required bank(s) of capacitors may be switched under partial load conditions. Such operations of individual banks shall be automatic.

Where the PF capacitors are provided in banks, each bank shall be controlled by suitably rated switch gear with HRC fuses.

The capacitor banks and the controlling switchgear may be fabricated in independent cubical or may form part of the switchboard in the installations. In the latter case, the capacitors are permitted to be mounted on the switchboard, if so desired.

8) REMOTE CONTROL CUM INDICATING PANEL

The remote control cum indicating panel shall be provided in the plant room. This panel shall have necessary push buttons for on and off controls and status indication of all electric motors except for small motors as of humidifiers of AHUs and FCUs. However, if BMS system is provided, remote control-cum- indicating panel shall not be required.

In view of (i) above, push buttons need not be provided as part of the starters in the switch boards, except of the AHU blower motors. In the case of the AHU blower motors, push buttons shall be provided as part of the starters for local on and off operations.

Back indication to show the status of operation of all the motors (except small motors as in humidifiers of AHUs and FCUs) and also of the electric strip heaters (AHU wise) shall be provided.

Panel shall be fabricated from 1.6 mm thick steel sheet. This shall be of freestanding floor mounting type design. This shall be complete with necessary termination arrangements, multicore cables, tag blocks, control transformer, designation plastic labels, double earth studs etc. as required.

9) MOTOR STARTER

The motor starter shall conform to IS: 1822 —Motor starters of voltage not exceeding 1000 volts|| and shall be air insulated and suitable for 415 volts, + 10%, 50 Hz., 3 phase AC supply. Enclosures shall have protection of IP 42 for Indoor applications and IP 55 for outdoor applications.

Starter for the motor shall be direct on line (D.O.L) for motors up to and including 7.5 H.P. rating and automatic star-delta close transition type for motors of higher ratings unless otherwise specified in the tender specifications. Starters shall be rated for intermittent duty. Starting current should not exceed two times the full load current.

The starter shall be mounted on the main electrical control panel/ unit mounted/ self mounted as specified.

Each starter shall be provided with the following protections: -

- Thermal overload on all the three phases with adjustable settings,

Under voltage protection, and Independent single phasing preventer. (Current sensing type)

- Adequate number of extra NO/ NC contacts for interlocks, indicating lamps etc. shall be provided on the starter/ contactor.

PAINTING

All panels shall be supplied with the manufacturer's standard finish painting or as indicated in the Schedule of Work.

a) MOTOREFFICIENCY

All permanently wired poly-phase motors of 0.375 kW or more serving the building and expected to operate more than 1500 hours per year and all permanently wired poly phase motors of 50 kW or more serving the building and expected to operate more than 500 hours per year shall have a minimum acceptable nominal full load motor efficiency not less than IE3 class as per IS 12615 for Energy Efficient motors.

Motors of horsepower differing from those listed in the table shall have efficiency greater than that of the listed kW motor. See Annexure N.

Motor horsepower ratings shall not exceed 20% of the calculated maximum load.

Motor nameplates shall list the nominal full load motor efficiencies and the full load power factor.

Motor users should insist on proper rewinding practices for rewound motors. If the proper rewinding practices cannot be assured, the damaged motor should be replaced with a new, efficient one rather than suffer the significant efficiency penalty associated with typical rewind practices.

Certificates shall be obtained and kept on record indicating the motor efficiency. Whenever a motor is rewound, appropriate measures shall be taken so that the core characteristics of the motor is not lost due to thermal and mechanical stress during removal of damaged parts. After rewinding, a new efficiency test shall be performed and similar records shall be maintained.

Motors should be installed with soft start energy savers and Variable Speed drives based on the application required.

Specific Conditions of Contract - Operation & Maintenance

1. General:-

- a. The scope of Operation & Maintenance (O&M) of various Civil & E&M works at Government Medical colleges to be executed by the EPC Contractor has been detailed in the Specific Conditions of Contract- General, which may be referred to.
- b. The proposed completion period for construction of Government Medical colleges is 18 months for construction (staggered in various phases) plus 12 months towards defect liability period. O&M activities shall be provided for different phases from the completion of work and handing over of respective phases and upto the expiry of the defect liability period of complete project which shall be 12 months beyond the overall completion of the total project.
- c. Contract Agreement for O & M Services shall be executed directly between Administrative Department & OEM operator under a separate agreement to be executed at appropriate stage.
- d. The Operation, CMC & AMC for various components of work shall be carried out as per following table:

SR. NO.	DESCRIPTION OF WORK	CMC	AMC	OPERATION
1	Electrical Substations HT/ LT works	-	R	R
2	DG Works including HSD Storage & Fuel Pumping System	-	R	R
3	Lifts	-	R	-
4	STP cum ETP/STP	R	-	R
5	Fire Fighting System	R	-	R
6	LV works i.e. CCTV /Access Control/ LAN/ IPABX/ information Display/ Audio Visual System Stage Lighting/ Public Address/ Fire Alarm/BMS/NCS/SCADA etc.	-	R	R
7	Civil & Internal Electrification, Street Lighting, Boom Barrier, Horticulture and Landscaping	-	R	-
Note:- R= Required Services				

2. Phase Wise Segregation of Various Buildings With DLP & Completion Period

- a. The period for completion of construction of different milestones with phases of work shall be as given in Volume 1
- b. The commencement of DLP shall start after completion of construction of respective milestones with phases of work as given in Volume 1
- c. The DLP for respective milestone/phases and overall completion of project shall be upto 12 months from the date of overall completion of project or extended period thereof.

FORMATS FOR GUARANTEES**GUARANTEE TO BE EXECUTED BY THE CONTRACTOR FOR REMOVAL OF DEFECTS
AFTER COMPLETION IN RESPECT OF WATER SUPPLY AND SANITARY INSTALLATIONS****(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One hundred Only))**

The agreement made this..... Day of Two thousand and between
.....

S/O..... (hereinafter called the GUARANTOR of the one part) and the (hereinafter called the UPPWD of the other part). WHEREAS THIS agreement is supplementary to the contract. (Herein after called the Contract) dated... and made between the GUARANTOR OF THE ONE PART

AND the UPPWD of the other part, whereby the contractor inter alia, undertook to render the work in the said contract recited structurally stable workmanship and use of sound materials.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said work will remain structurally stable and guarantee against faulty workmanship, finishing, manufacturing defects of materials and leakages etc.

NOW THE GUARANTOR hereby guarantee that work executed by him will remain structurally stable, after the expiry of maintenance period prescribed in the contract for the minimum life of ten years, to be reckoned from the date of completion of work, to be reckoned after the expiry of maintenance period prescribed in the contract.

The decision of the Engineer- in- charge with regard to nature and cause of defects shall be final.

During the period of guarantee the guarantor shall make good all defects to the satisfaction of the Engineer- in- charge calling upon him to rectify the defects, failing which the work shall be got done by the UPPWD by some other contractor at the guarantor's cost and risk. The decision of the Engineer -in- charge as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to make good all the defects, commits breach there-under then the guarantor will indemnify the Principal and his successor against all loss, damage cost expense or otherwise which may be incurred by him by reason of any default on the part of THE GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and/or cost incurred by the UPPWD the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator and by for and on behalf of the UPPWD on the day, month and year first above written.

Signed sealed and delivery by OBLIGATOR in the presence of:

- 1.
- 2.

SIGNED FOR AND ON BEHALF OF-----BY in the present of:

- 1.
- 2.

GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR FOR ANTI TERMITE TREATMENT.

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One hundred Only)

The agreement made this day of two thousand and between S/o
(hereinafter called the GUARANTOR of the one part) and the-----
(hereinafter called the UPPWD of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) dated and made between the GUARANTOR OF THE ONE PART AND the UPPWD of the other part, whereby the contractor interalia, undertook to render the building and structures in the said contract recited completely Anti Termiteproof.

AND WHEREAS GUARANTOR hereby guarantee that the effect that the building and structures will remain completely Anti Termite proof for TEN years, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

NOW THE GUARANTOR hereby guarantees that Anti Termite treatment given by him under agreement Item No., will render the structure completely Anti Termite proof and the minimum life of such Anti Termite treatment given by him will render the structures completely leak proof and the minimum life of such Anti Termite treatment shall be TEN years, to be reckoned from the date of completion of work.

Provided that THE GUARANTOR shall be not responsible for leakage caused by earth quake or structural defects or misuse of Building or alteration and for such purpose:

- a. misuse of Building shall mean any operation which will Anti Termite treatment to the Building.
- b. Alteration shall mean construction of any addition or construction adjoining to existing Building whereby Anti Termite treatment is removed/damaged in parts;
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee the guarantor shall make good all defects and in case of any defect being found to render the Anti Termite proof treatment of the building to the satisfaction of the Engineer at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer calling upon him to rectify the defects failing which the work shall be got done by the UPPWD by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the Anti Termite treatment, or commits breach there-under then the guarantor will indemnify the Principal and his successor against all loss, damage, cost of expenses or otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement.

As to the amount of loss and/or cost incurred by the UPPWD on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator and by by for and on behalf of on the day, month and year first abovewritten.

Signed sealed and delivered by OBLIGATOR in presence of:

1.

SIGNED FOR AND ON BEHALF OF BY In presence of:

1.

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR FOR WATER PROOFING
TREATMENT FOR BASEMENTS.**

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One hundred Only))

The agreement made this day of two thousand and between S/o (hereinafter called the GUARANTOR of the one part) and the-----

(hereinafter called the UPPWD of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) dated and made between the GUARANTOR OF THE ONE PART AND the UPPWD of the other part, whereby the contractor inter alia, undertook to render the building and structures in the said contract recited completely water and leak proof.

AND WHEREAS GUARANTOR hereby guarantee that the effect that the building and structures will remain completely water and leak proof for TEN years, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

NOW THE GUARANTOR hereby guarantees that water proofing treatment given by him under agreement Item No., will render the structure completely leak proof and the minimum life of such water proofing treatment given by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be TEN years, to be reckoned from the date of completion of work.

Provided that THE GUARANTOR shall be not responsible for leakage caused by earth quake or structural defects or misuse of Basement or alteration and for such purpose:

- a. misuse of basement shall mean any operation which will damage proofing treatment to the basement of the Building.
- b. Alteration shall mean construction of any addition or construction adjoining to existing basement whereby proofing treatment is removed in parts;
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee the guarantor shall make good all defects and in case of any defect being found render the building water proof to the satisfaction of the Engineer at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer calling upon him to rectify the defects failing which the work shall be got done by the UPPWD by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the water proofing, or commits breach there-under then the guarantor will indemnify the Principal and his successor against all loss, damage, cost of expenses or otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement.

As to the amount of loss and/or cost incurred by the UPPWD on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator and by for and on behalf of on the day, month and year first above written.

Signed sealed and delivered by OBLIGATOR in presence of:

1. 2.

SIGNED FOR AND ON BEHALF OF BY In presence of:

1. 2.

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR FOR WATER PROOFING
TREATMENT FOR ROOF.**

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One hundred Only))

The agreement made this day of two thousand and _between S/o _____ (herein after called the GUARANTOR of the one part) and the-----

(hereinafter called the UPPWD of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) dated and made between the GUARANTOR OF THE ONE PART AND the UPPWD of the other part, whereby the contractor inter alia, undertook to render the building and structures in the said contract recited completely water and leak proof.

AND WHEREAS GUARANTOR hereby guarantee that the effect that the building and structures will remain completely water and leak proof for TEN years, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

NOW THE GUARANTOR hereby guarantees that water proofing treatment given by him under agreement Item No....., will render the structure completely leak proof and the minimum life of such water proofing treatment given by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be TEN years, to be reckoned from the date of completion of work.

Provided that THE GUARANTOR shall be not responsible for leakage caused by earth quake or structural defects or misuse of Basement or alteration and for such purpose:

- a. misuse of roof shall mean any operation which will damage proofing treatment like chopping of fire wood and things of the same nature which might cause damage to the roof of the building.
- b. Alteration shall mean construction of any additional storey or part of the roof or construction adjoining to existing roof whereby proofing treatment is removed in parts;
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee the guarantor shall make good all defects and in case of any defect being found to render the building water proof to the satisfaction of the Engineer at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer calling upon him to rectify the defects failing which the work shall be got done by the UPPWD by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the water proofing, or commits breach there-under then the guarantor will indemnify the Principal and his successor against all loss, damage, cost of expenses or otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement.

As to the amount of loss and/or cost incurred by the UPPWD on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator and by for and on behalf of on the day, month and year first above written.

Signed sealed and delivered by OBLIGATOR in presence of:

1. 2.

SIGNED FOR AND ON BEHALF OF BY in presence of:

- 1.

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR FOR WATER PROOFING
TREATMENT(UNDER FLOORS).**

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One hundred Only)

The agreement made this day of two thousand and between S/o (hereinafter called the GUARANTOR of the one part) and the -----

(hereinafter called the UPPWD of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) dated and made between the GUARANTOR OF THE ONE PART AND the UPPWD of the other part, whereby the contractor inter alia, undertook to render the toilets, terraces and such related areas of the building in the said contract recited completely water and leakproof.

AND WHEREAS GUARANTOR hereby guarantee that the effect that the said toilets, terraces and such related areas will remain completely water and leak proof for TEN years, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

NOW THE GUARANTOR hereby guarantees that water proofing treatment under the floors in toilets, terraces and such related areas given by him under the contract, will render the areas completely water and leak proof and the minimum life of such water proofing treatment shall be TEN years, to be reckoned from the date of completion of work i.e. to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

Provided that THE GUARANTOR shall be not responsible for leakage caused by earth quake or structural defects or misuse of floors or alteration and for such purpose:

- a. misuse of such floors shall mean any operation which will damage proofing treatment and things of the same nature which might cause damage to the such floors of the building.
- b. Alteration shall mean construction of any addition or construction adjoining to existing such floors whereby proofing treatment is removed in parts;
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee the guarantor shall make good all defects and in case of any defect being found to render the building water proof to the satisfaction of the Engineer at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer calling upon him to rectify the defects failing which the work shall be got done by the UPPWD by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the water proofing, or commits breach there-under then the guarantor will indemnify the Principal and his successor against all loss, damage, cost of expenses or otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement.

As to the amount of loss and/or cost incurred by the UPPWD on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator and by for and on behalf of on the day, month and year first above written.

Signed sealed and delivered by OBLIGATOR in presence of:

1. 2.

SIGNED FOR AND ON BEHALF OF BY In presence of:

1. 2.

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR IN RESPECT
OF ALUMINIUM WORKS.**

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One hundred Only))

The agreement made this day of two thousand and between S/o (here in after called the GUARANTOR of the one part) and the-----

(hereinafter called the UPPWD of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) dated and made between the GUARANTOR OF THE ONE PART AND the UPPWD of the other part, whereby the contractor interalia, undertook to render the Aluminum Works in the said contract recited safe against water leakage, unsound material and workmanship and defective anodizing etc..

AND Whereas GUARANTOR agreed to give a guarantee to the effect that the Aluminum Work will remain safe against water leakage, unsound material and workmanship and defective anodizing for TEN years from the date of completion of work, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

NOW THE GUARANTOR hereby guarantees that the Aluminum Works executed by him will remain safe against water leakage, unsound material and workmanship and defective anodizing for TWO years from the date of completion of work, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

Provided that the guarantor shall not be responsible for any damage caused by earth quake or misuse of the Aluminum Work or alteration and for such purpose:

- a. misuse of the Aluminum Work shall mean any operation which will damage the Aluminum Work executed by him;
- b. Alteration shall mean construction of an addition to the Aluminum Work executed by him or part thereof or construction adjoining to the existing Aluminum Work whereby the Aluminum Work is likely to be effected/damaged;
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee the guarantor shall make good all defects and in case of any defect being found to render the Aluminum Work to the satisfaction of the Engineer at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer calling upon him to rectify the defects failing which the work shall be got done by the UPPWD by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the water proofing, or commits breach there-under then the guarantor will indemnify the Principal and his successor against all loss, damage, cost of expenses or otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or cost incurred by the UPPWD on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator and by for and on behalf of on the day, month and year first abovewritten.

Signed sealed and delivered by OBLIGATOR in presence of:

1.

SIGNED FOR AND ON BEHALF OF BY In presence of:

1.

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR IN RESPECT
OF STRUCTURAL GLAZING/ CURTAIN WALL SYSTEM/WORKS.**

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One hundred Only)

The agreement made this day of two thousand and between S/o (hereinafter called the GUARANTOR of the one part) and the-----

(hereinafter called the UPPWD of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) dated and made between the GUARANTOR OF THE ONE PART AND the UPPWD of the other part, whereby the contractor interalia, undertook to render the Structural Glazing / Curtain Wall System/ work under agreement ItemNo_ safe against water leakage, unsound material and workmanship and defective anodizingetc..

AND Whereas GUARANTOR agreed to give a guarantee to the effect that the Structural Glazing/ Curtain Wall System/Work will remain safe against water leakage, unsound material and workmanship and defective anodizing for FIVE years from the date of completion of work, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

NOW THE GUARANTOR hereby guarantees that the Structural Glazing/ Curtain Wall System /Work executed by him will remain safe against water leakage, unsound material and workmanship and defective anodizing for FIVE years from the date of completion of work, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

Provided that the guarantor shall not be responsible for any damage caused by earth quake or misuse of the Structural / Curtain Wall System/ Work or alteration and for such purpose:

- a. misuse of the Structural Glazing / Curtain Wall System /Work shall mean any operation which will damage the Structural Glazing / Curtain Wall System /Work executed by him;
- b. Alteration shall mean construction of an addition to the Structural Glazing / Curtain Wall System Work executed by him or part thereof or construction adjoining to the existing Structural Glazing / Curtain Wall System / Work whereby the Structural Glazing / Curtain Wall System/Work is likely to be effected/ damaged;
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee, the guarantor shall make good all defects and in case of any defect being found to render the Structural Glazing / Curtain Wall System /Work to the satisfaction of the Engineer-in- Charge at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer calling upon him to rectify the defects failing which the work shall be got done by the UPPWD by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if Guarantor fails to rectify the Structural Glazing / Curtain Wall System /work or commits breach there under then the Guarantor will indemnify the Principal and his successors against all loss, damage, cost, expense or otherwise which may be incurred by him by reason of any default on the part of the Guarantor in performance and observance of the supplementary agreement. As to the amount of loss and/ or damage and/or cost incurred by UPPWD, the decision of Engineer will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator and by for and on behalf of on the day, month and year first above written.

Signed sealed and delivered by OBLIGATOR in presence of:

1.

SIGNED FOR AND ON BEHALF OF BY In presence of:

1.

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR IN RESPECT OF SEISMIC/
MECHANICAL JOINT WORKS.**

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One hundred Only)

The agreement made this day of two thousand and between S/o _____ (hereinafter called the GUARANTOR of the one part) and the (hereinafter called the UPPWD of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) dated _____ and made between the GUARANTOR OF THE ONE PART AND the UPPWD of the other part, whereby the contractor inter alia, undertook to render the Seismic/ Mechanical Joint System/Work under agreement Item No _____ in the said contract recited safe against water leakage, unsound material and workmanship and defective anodizing etc..

AND Whereas GUARANTOR agreed to give a guarantee to the effect that the Seismic/ Mechanical Joint System/Work will remain safe against water leakage, unsound material and workmanship and defective anodizing for TEN years from the date of completion of work, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

NOW THE GUARANTOR hereby guarantees that the Seismic/ Mechanical Joint System/Works executed by him will remain safe against water leakage, unsound material and workmanship and defective anodizing for TWO years from the date of completion of work, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

Provided that the guarantor shall not be responsible for any damage caused by earth quake or misuse of the Seismic/ Mechanical Joint System/Work or alteration and for such purpose:

- a. misuse of the Seismic/ Mechanical Joint System/Work mean any operation which will damage the Aluminum Work executed by him;
- b. Alteration shall mean construction of an addition to the Seismic/ Mechanical Joint System/Work executed by him or part thereof or construction adjoining to the existing Seismic/ Mechanical Joint System/Work where by the Seismic/Mechanical Joint System/Work is likely to be effected/damaged;
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee, the guarantor shall make good all defects and in case of any defect being found to render the Seismic/ Mechanical Joint System/Work non-functional to the satisfaction of the Engineer at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer – in-charge calling upon him to rectify the defects failing which the work shall be got done by the UPPWD by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the Seismic/ Mechanical Joint System/Work, or commits breach there- under then the guarantor will indemnify the principal and his successor against all loss, damage, cost of expenses or otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or cost incurred by the UPPWD on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator and by for and on behalf of on the day, month and year first above written.

Signed sealed and delivered by OBLIGATOR in presence of:

1. _____ 2. _____

SIGNED FOR AND ON BEHALF OF _____ BY _____ In presence of:

1. _____ 2. _____