

**EXTERNAL DEVELOPMENT WORKS
IN STAFF QUARTERS AND PET-CT AT
JIPMER, PUDUCHERRY**

**Volume- III
TECHNICAL SPECIFICATION**

**Tender No: HLL/IDD/CHN/18-19/020
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CHAPTER B

TECHNICAL SPECIFICATIONS AND CONDITIONS- CIVIL WORKS

1. EARTH WORK: As per relevant CPWD specifications.

- a. Irrespective of the stipulations in the relevant CPWD Specifications or elsewhere in the Contract, the excavated earth shall be disposed of by the contractor at his own cost to the place as directed by Engineer – in-charge and/or permitted by the local authority after obtaining written permission of the Engineer – in-charge and no payment will be made by the HLL for disposal of this excavated earth.
- b. The Contractor shall, at his own expense and without extra charges, make provision for all shoring, pumping, dredging or bailing out water, encountered from any sources such as rains, floods, springs, subsoil water table being high or due to any other cause whatsoever. The foundation trenches shall be kept free from water while all the works below ground level are in progress without any extra payment.
- c. Filling in plinth shall be consolidated with water and compacted with pneumatic rammers, to achieve 90% relative density on testing. One test is to be carried out for 1000 sq.ms. of compacted area.

2. PLAIN CEMENT CONCRETE AND REINFORCED CEMENT CONCRETE WORK:

A. STONE AGGREGATE:

- i. Stone aggregate used in the work shall be of hard broken stone to be obtained from approved source (Quarries to be approved by the Engineer in charge) and shall conform to relevant provision in the Latest CPWD Specifications for works.

B. M-SAND

- i. M-Sand to be used for the work shall be of as specified in the latest CPWD Specifications. M-Sand shall be obtained from the source to be got approved by the Engineer in charge and washed if required, with appropriate equipment to bring down the chemical, inorganic and organic impurities within the permissible limits as per the direction of the Engineer in charge. The same shall consist of hard siliceous materials.

Note: Where only one variety of M-sand is available the M-sand will be sieved for use in finishing work as directed by the Engineer – in – charge in order to obtain smooth surface and nothing extra will be paid on this account.

- ii. Nothing extra shall be paid for screening or washing the sand as prescribed above.

C. FLYASH

Flyash conforming to grade 1 of IS 3812 (Part 1) may be used as part replacement of OPC provided uniform blending with cement is ensured in accordance with clauses 5.2 and 5.2.1 of I.S.456-2000 in the items of BMC and RMC. However this shall not override the provisions of the respective items.

D. CENTERING SHUTTERING AND SCAFFOLDING:

- i. All Scaffolding centering for RCC shall be with properly designed system and brought to site well in advance so that the progress of the work is not hampered for non-availability of the same.
- ii. All shuttering for RCC work except soffits of slab shall be in water proof shuttering Ply. Shuttering for slab and soffits shall be in water proof shuttering ply or in good

quality mild steel plates free of dents, bends or warping and rusting as approved by the Engineer in charge.

- iii. Contractor should deploy complete one set of shuttering materials for minimum one complete floor and the shuttering material for beam bottom shall be minimum for two complete floors.

E. REINFORCEMENT:

- i. TMT reinforcement steel shall be used shall be as per design and conforming to IS: 1786 pertaining to Fe 500D OR Fe 550D grade of steel, as per the BOQ.
- ii. TMT steel bars manufactured by main producers, as per list of makes, shall be allowed in the work. Contractor shall produce manufacturer Test Report for each dia and each lot Tests. Nothing extra will be paid for "straightening of bars" received from market in coils or with bends. All incidental charges of any kind whatsoever including cartage, storage, safe custody of materials, cutting and wastage etc. shall be borne by the contractor.
- iii. The actual average sectional weight for dia up to 10 mm shall be arrived at from one meter long samples (minimum 3 from each dia) taken from each lot of steel. The discretion of the Engineer – in – charge shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site of work each day will constitute the single lot for this purpose.
- iv. The weight of each lot of a particular diameter of 10mm and below shall be reckoned as the weight as per actual issue multiplied by a factor equal to the standard sectional weight of the particular diameter divided by the average sectional weight of the particular dia in a particular lot worked out as per above para. Adjustment for the steel shall be effected on the basis of the weight as modified above for quantity payable.
- v. Measurement of all diameters of steel be on linear basis and will be converted into weight on the basis of standard sectional weight coefficients given in relevant CPWD specifications mentioned in schedule 'F' of General Conditions of Contract.
- vi. Measurement of reinforcement shall be as per procedure described in the relevant CPWD specifications mentioned in schedule 'F' of General Conditions of Contract.

F. Concrete Mix Design

The mix design shall be for MODERATE exposure and GOOD degree of quality control, unless otherwise specified.

G. Concrete Batching Plant (Design Mix)

- i. The Concrete Batching Plant of suitable capacity to be installed, as per requirement at site, within a period of 30 days from award of work. The contractor shall install batching plants (within 50 meters distance from the site of work) supplying Concrete at site. The batching plant proposed to be engaged by the contractor shall fulfill the following requirements.
 - 1. It shall be fully computerized.
 - 2. Facility to pump concrete upto the highest point of the building.
 - 3. It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.
 - 4. It should have sufficient capacity to meet the requirement as per schedule.

In case of failure of Batching Plant, RMC may be allowed with a written permission of the Engineer in Charge

- ii. Approved admixtures conforming to IS.9103 shall be permitted to be used. The chloride content in the admixture shall satisfy the requirement of BS 5075. The total amount of chloride content in the admixture mixed Concrete shall satisfy the requirement of IS 456-2000.
- iii. The concrete mix design with and without admixture will be carried out by the contractor through the Laboratories / Test house as approved by Engineer-in-charge.
- iv. The various ingredients for mix design \laboratory tests shall be sent to the lab test house through the Engineer and the sample of such ingredients sent shall be preserved at site by the department till completion of work or change in Design Mix whichever is earlier. The sample shall be taken from the approved materials which are proposed to be used in the work.
- v. The batching and mixing plant shall be fully automatic.
- vi. The contractor has to arrange to erect batching plant for the design mix concrete on his own.
- vii. The concrete shall be transported to the site in specially made Transit Mixers & shall have suitable retarders so that it should not set before placing in position. It should have sufficient flow so that at height the concrete shall be placed by pumping only.
- viii. Each Transit Mixer reaching site shall invariably have manufacturer's certificate containing details like truck number Grade of mix, time of leaving the plant, time of reaching a site etc. A copy of the same shall be handed over to E- in - C or his authorized representative.
- ix. However samples for testing etc. shall be taken as per the mandatory tests prescribed in latest CPWD specifications.
- x. All cubes shall be tested for 7 days and 28 days tests in conformity with the relevant CPWD specifications.
- xi. In respect of projected balconies, projected slabs at roof level and projected verandah, the payment for the RCC work shall be made under the items of RCC slabs. Nothing extra shall be paid for the side shuttering at the edges of these projected balconies and projected verandah. All the exposed edge shall however be finished as per specifications and nothing extra shall be paid for this.
- xii. In the items of RCC walls, railings and roofs etc. nothing extra shall be paid for making designs as per patterns given by Engineer-in-charges or for thickness of sections.
- xiii. The water will be tested with regard to its suitability for use in CC/RCC work and nothing extra will be paid for on this account.
- xiv. To receive anchor bolt / foundation for machines to be installed at later date, pocket of size minimum 110x100x300 mm shall be kept while concreting of RCC/ CC members and shall be filled with CC 1:1:2 with plasticizer and as per the direction of Engineer in charge.

H. Ready Mix Concrete (RMC)

- i. The contractor shall engage Ready Mix Concrete (RMC) producing plants (Distance of plant from site to be approved by Engineer in Charge) to supply RMC for the work.

The RMC plant proposed to be engaged by the contractor shall fulfill the following requirements.

- a) It shall be fully computerised.
- b) It should have supplied RMC for Govt. projects of similar magnitude.
- c) It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.
- ii. The Ready Mix Concrete (RMC) producing plants of the main Cement producers shall be preferred.
- iii. The contractor shall, within 10 days of award of the work submit list of at least three reputed RMC plant companies along with details of such plants Including details of transit mixer, pumps etc. to be deployed indicating name of its CLIENT/company, its location, capacity, technical establishment, past experience for approval by Engineer-in-charge.
- iv. The Engineer-in-Charge reserves the right to exercise check over the:-
 - a) Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials recordings of test results and declaring the material fit or unfit for use in production of mix.
 - b) Calibration check of the RMC.
 - c) Weight and quality check on the ingredient, water and admixture added for batch mixing.
 - d) Time of mixing of concrete.
 - e) Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action.

For exercising such control, the Engineer shall periodically depute his authorized representative at the RMC plant. It shall be the responsibility of the contractor to ensure that the necessary equipment manpower & facilities are made available to Engineer and/or his authorized representative at RMC plant

- v. Ingredients, admixtures & water declared unfit for use in production of mix shall not be used. A batch mix found unfit for use shall not be loaded into the truck for transportation.
- vi. All required relevant records of RMC shall be made available to the Engineer or his authorized representative. Engineer shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production and transportation of concrete mix which shall be binding on the contractor & the RMC plant.
- vii. It shall be the responsibility of the Contractor to ensure that the RMC producer provides all necessary testing equipment and takes all necessary measures to ensure Quality control of ready -mixed concrete. In general the required measures shall be:-
 - a) **CONTROL OF PURCHASED MATERIAL QUALITY**

RMC producer shall ensure that the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standards with the material Supplier and the requirement of the product mix design and quality control producer's. This shall be accomplished by visual checks, sampling and testing, certification from materials suppliers and

information /data from material supplier. Necessary equipment for the testing of all material shall be provided and maintained in calibration condition at the plant by the RMC producer.

b) CONTROL OF MATERIAL STORAGE

Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for prevention of contamination, reliable transfer and feed system, drainage of aggregates, prevention of freeing or excessive solar heating of Aggregate etc,

c) RECORD OF MIX DESIGN AND MIX DESIGN MODIFICATION

RMC producer shall ensure that record of mix design and mix design modification is available in his computer at RMC plant for inspection of Engineer or his representative at any time.

d) COMPUTER PRINT OUTS OF EACH TRUCK LOAD

Each truckload / transit mixer dispatched to site shall carry computer printout of the ingredients of the concrete it is carrying. The printout shall be produced to Engineer or his representative at site before RMC issued in work.

e) TRANSFER AND WEIGHING EQUIPMENT RMC

Producer shall ensure that a documented calibration is in place. Proper calibration records shall be made available indicating date of next calibration due, corrective action taken etc. RMC producer shall ensure additional calibration checks whenever required by the Engineer in writing to contractor. RMC producer shall also maintain a daily production record including details of mixes supplied. Record shall be maintained of what materials were used for that day's production including water and admixtures.

f) MAINTENANCE OF PLANT, TRUCK Mixers AND PUMPS

Plant, Truck Mixers and Pumps should be well maintained so that it does not hamper any operation of production, transportation and placement.

g) PRODUCTION OF CONCRETE

The following precautions shall be taken during the production of RMC at the plant

- i) Weighing (correct reading of batch data and accurate weighing):- For each load, written, printed or graphical records shall be made of the weights of the materials batched, the estimated slump, the total amount of water added to load the delivery tickets number for that load and the time of loading the concrete into the truck.
- ii) Visual observation of concrete during production and delivery or during sampling and testing of fresh concrete assessment of uniformity, cohesion, workability adjustment to water content. The workability of the concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.
- iii) Use of adequate equipment at the plant to measure surface moisture content of aggregates, particularly fine aggregates or the workability of the concrete, cube tests etc. shall also be ensured.

- iv) Making corresponding adjustment at the plant automatically or manually to batched quantities to allow for observed, measured or reported changes in materials or concrete qualities.
- v) Sampling of concrete, testing monitoring of results.
- vi) Diagnosis and correction of faults identified from observations /complaints.

The RMC plant produced concrete shall be accepted by Engineer at site after receipt of the same after fulfilling all the requirements of mix mentioned in the tender documents.

- viii. The rate for the Item of design mix cement concrete shall be inclusive of all the ingredients including admixtures, if required, labour, machinery T&P etc. (except shuttering which will be measured & paid for separately) required for a design mix concrete of required strength and workability. The rate quoted by the agency shall be net & nothing extra shall be payable on account of change in quantities of concrete, ingredients like cement and aggregates and admixtures etc. as per the approved mix design.
- ix. Ready mix concrete shall be arranged in quantity as required at site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by Engineer.
- x. Frequency of sampling and standards of acceptance shall be as per CPWD specifications.
 - i) No addition of water or other ingredients shall be permitted in the RMC at site or during transit.
 - ii) The RMC shall be placed by pump of suitable capacity and the contractor shall arrange sufficient length of pipe at site to place the RMC in the minimum required time. The contractor shall co-ordinate with RMC supplier and pumps hirer to have effective concrete placement.
 - iii) Pre-paid delivery tickets shall be produced with each truck load of RMC.
 - iv) The representative of RMC supplier shall attend the site meeting as and when decided by the Engineer
- xi.
 - i) The contractor shall assess the quantity of RMC requirement at site well in advance and order accordingly to the RMC supplier. In case excess RMC is received at site, the department shall not be under any obligation to get extra quantities utilized and no payment for such RMC shall be made.
 - ii) The contractor shall have to employ labour in shifts to ensure continuous casting of raft and other RCC members. No extra payment on this account shall be made.

3. WATER PROOFING TREATMENT (PRE-CONSTRUCTION) BY CHEMICAL INJECTION SYSTEM

A. HORIZONTAL SURFACE (RAFT SLAB)

- i. Before the raft reinforcement is placed in position:
 - a. Laying PCC as per drawings and specifications.(payable under the corresponding item)
 - b. Cement slurry (cement and approved water proofing compound) is spread on the PCC for proper bonding with subsequent water proofing treatment.

- c. Water Proofing Course of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) mixed with approved water proofing compound is laid over the slurry. Stone aggregates 12mm down is embedded at random.
 - d. After 24 hours, spreading cement slurry (cement and approved water proofing compound) on the 1st layer of mortar.
 - e. Providing and laying 2nd layer of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) mixed with approved water proofing compound. Stone aggregate 12mm down size is embedded at random.
- ii. After reinforcement of raft is placed in position:
- a. Providing and fixing 25mm dia GI threaded grouting nozzles of adequate length at the specified locations @ 1.50 metres c/c or as shown in the drawing all over the slab. The grouting nozzles are tied with reinforcement in such a manner as not to choke its end during concrete operations. The top of these nozzles protrudes above the raft concrete.
 - b. After minimum 7 days of concreting, cement grout of cement and approved water proofing compound (non-shrinkage grouting compound) in proportion as specified is injected, through these nozzles at the pressure of 2.5 to 3.0 Kg/Sq.cm.
 - c. After grouting, top of the nozzles is cut and the space is filled with cement mortar 1:2 (1 cement: 2 coarse sand) mixed with approved water proofing compound.

B. Retaining Wall

- a. The external surface is prepared and approved cement slurry is applied.
- b. Providing and laying 25mm thick cement mortar in 1:4 (1 cement : 4 coarse sand) mixed with approved water proofing compound in two layers with chicken wire mesh 26 or 24 gauge 25mm size in between the two layers.
- c. The G.I. pipes are placed at 1.5m c/c in both directions, and, 0.75 m C/C along construction joints and securely fastened to the reinforcement prior to shuttering and concreting or alternately by drilling holes (25mm to 32mm dia) in the concrete upto a depth as shown in the drawing all over the wall surface @ 1.50mt. C/C and as shown in the drawing. Treatment along all construction joints by providing nozzles, as above, shall also be executed.
- d. Fixing 25mm dia G.I. threaded nozzles in these holes with cement mortar 1:4 (1 cement: 4 coarse sand) mixed with water proofing compound.
- e. Injecting cement grout of cement and polymer based water proofing compound (non-shrinkage grouting compound) in proportion as specified in these nozzles at a pressure of 2.5 to 3.0 Kg/Sq.cm.
- f. After the grout the nozzles are cut and filled with cement mortar 1:2 mixed with polymer based water proofing compound in proportion as specified and finished smooth.

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

C. Guarantee for water proofing:

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

D. Measurements:

The length and breadth shall be measured correct to cm. The flooring area shall be measured in sq.ms. actually executed in raft slab. Inside wall surfaces of the basement upto ground level from top of raft slab shall be measured in sq.ms. Columns cross sections area not to be deducted from the plan area.

E. Rate:

Rates shall be inclusive of all operations including labour, material, T&P, scaffolding etc. complete. Nothing extra shall be payable on any account.

4. BRICK WORK

- a. Bricks used in the work shall be obtained from kilns to be got approved from the Engineer in charge and shall be best quality well burnt ground moulded bricks as available in the vicinity. They shall have a compressive strength of not less than 75 Kgs/sq.cm and an absorption percentage of not more than 15 (Fifteen) % of its dry weight when immersed in water for 24 hours. In all other respects they shall conform to the provision in Latest CPWD Specifications for works.
- b. Both the face of wall of thickness more than 23cm shall be kept in the proper plane. Walls of half brick thickness or less shall be measured separately and paid in sqm.
- c. Bricks wall beyond half brick thickness shall be measured in multiple of half brick (i.e. more than 115mm or equivalent) which shall be deemed to be inclusive of mortar joints. In all other respects they shall conform to the provision in relevant specifications of the work.
- d. For mortar, use of PP Cement shall be preferred.

5. CEMENT PLASTER: - The use of PP Cement shall be preferred.

6. WOOD WORK:

- a. Timber required for manufacture of chowkhats and shutters for doors, windows, ventilators, partitions etc shall be Forest Stewardship council (FSC) certified wood and it shall be seasoned and preservative treated.
- b. The moisture contents of the wood used in the work shall not be more than that stipulated in the relevant clause of Latest CPWD Specifications for works. The rate quoted for various items shall be inclusive of kiln seasoning and preservative treatment of wood. In all other respects the wood used in the work shall conform to the provision in latest CPWD specification for works.
- c. The sample of species to be used shall be deposited by the contractor with the Engineer-in - charge before commencement of the work. The contractor shall produce cash voucher and certificate from standard kiln seasoning plant operator about the timber section to be used on the work having been kiln seasoned by them failing which it would not be so accepted as kiln seasoned.
- d. Glass :-
 - i. Transparent sheet glass (Float glass) conforming to IS 1761 – 1970 shall be used.
 - ii. Minimum thickness shall be governed as under, unless otherwise specified in the item.

AREA of Glazing		Max. Unsupported length	
For glazing area up to 0.5 sqm		120 cm	
For glazing area more than 0.5 sqm		120 cm	

iii. Glazing for toilet and in fixed ventilators shall be of frosted type.

e. Shutters:-

- i. Factory made shutters, as specified shall be obtained from factories to be approved by the Engineer – in – charge and shall conform to IS 2202 (Part –I) 1977. The contractor shall inform well in advance to the Engineer – in – charge the name address of the factory from where the contractor intends to get the shutters manufactured.
- ii. The contractor will place order for manufacture of shutters only after written approval of Engineer – in – charge in this regard is obtained. The contractor is bound to abide by the decision of the Engineer – in-charge. In case the factory already proposed by the contractor is not found competent to manufacture quality shutters, the Engineer – in – charge will recommend the name of another factory from the approved list.
- iii. The contractor will also arrange stage wise inspection of the shutters at factory with the Engineer in charge or his subordinate authorized representatives. Contractor will have no claim, if the shutters brought at site are rejected by the Engineer in charge in part or in full lot due to bad workmanship / quality or damages caused during their shifting from factory to site. Such shutters will not be measured and paid and the contractor shall remove the same from the site of work within 7 days after the written instruction in this regards are issued by the Engineer in charge or his authorized representatives.

7. STEEL GRILL WORK:

- a. All steel grills shall be according to the detailed drawings and obtained from approved suppliers. These shall conform to Latest CPWD Specifications for works.
- b. In case of grills an approved quality priming coat of zinc chromate shall be applied over and above a shop coat of primer. Nothing extra shall be payable for providing shop coat primer, but the zinc chromate primer, if additionally required, will be paid for separately.

8. ALUMINIUM WORKS

- A. The scope of the work is the fabrication, supply and erection at site of all types of Aluminium glazed doors, windows and ventilators in accordance with the drawings and specifications.
- B. The supply and erection will include all parts such as but not restricted to frames, tracks, guides, mullions, styles, rails, couplers, transoms, rails, plates glazing bars, glass, hinges, arrangement, spring catches, cord and pulley arrangements, spring catches, cord and pulley arrangements door closers floor springs etc., required for the whole work whether the parts/ items are individually and specifically referred to in the schedules/ specifications/drawings or not provided that the supply and installation of such parts can be inferred there from and are necessary to make the work complete, unless separate provision is made in the bills of quantities for supply to such parts/items.

C. The doors, windows, ventilators, will be fabricated to suit the finished clear openings in the building/structure which the tenderer will himself measure.

D. Materials:-

- i. The members will be made out of aluminum alloy corresponding to IS:733 and will consist of extruded sections and of other shapes, and to sized gauges as shown in the drawings/ described in accordance with the relevant IS codes. The members shall be chosen to provide strength/ stability and maximum resistance to wear and tear.
- ii. The Sections will be as per approved makes, extruded sections. As indicated in the drawings the tenderer should specifically mention which sections he is using.
- iii. The weight of sections and the corresponding catalogue numbers are mentioned. The IS specifications are to be strictly adhered.
- iv. The extruder using recycled materials may be preferred.
- v. The alloy of extruded aluminum should be BS or IS old HE9, Alcon 50 SWP. to this effect test certificate has to be provided for the extruder.

E. **Finishing:**

- i. The extruded aluminum section has to be mechanically finished to remove all scratches; extrusion marks etc and subsequently thoroughly cleared in all alkali baths prior to anodizing.
- ii. The polyester powder coating, as required, as per item of work, shall be of desired shade with minimum average thickness to 50 microns or other shades as required and to this effect the tenderer must have to produce test certificate from authorized institutions Bureau of Indian Standard.
- iii. The polyester powder coated material should be properly wrapped in gummed tape before fabrication to avoid scratches during fabricated and erection shall be kept protected till handing over.

F. **Fabrication:**

- i. Before commencing the fabrication the contractor shall submit to the Engineer – in - charge for their approval detailed shop drawings, based on the Architectural drawings and corresponding specification showing junctions, fittings, accessories such as hinges flush bolts, locks, latches, latching arrangements, peg stays, rotor arms, anodize pivots gaskets rubber packing door felts, mastic, sealant etc., including fixing and sealing arrangements . Type and method of scaffolding he intends to use, Fabrication is to be taken up only after approval by the Engineer – in - charge and in accordance with the approved drawings. Sections for fabrication of door/ window/ventilators etc shall be as per architectural drawings or as approved by the Engineer – in - charge.
- ii. A sample of finished door / windows/ ventilator railing etc.shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication,
- iii. The doors, window, ventilators and partitions shall be as per thickness given in the approved shop drawings, Polyester Powder coating shall be as specified in the item specifications.
- iv. All materials shall conform to relevant IS. Codes and in the absence of IS code, they should correspond to the best engineering practice; decision of the the Engineer – in - charge shall be final and binding on the contractor.

- v. Fabrication shall be done true to the drawing/ sample approved and in correspondence to the finished openings at the site. All joints shall be mitered at the corners, true right angles, and joints to be finished neatly to hairlines, with concealed fasteners, wherever possible joints shall be made in concealed locations.
 - vi. All fabricated/finished items shall be packed and carted properly to site to prevent any damage in transit. On receipt at site they shall be carefully stacked in protected storage to avoid distortion/damage.
 - vii. Site installation shall be with concealed screws, self-tapping or other approved fasteners or may be by welding, due precautions shall be taken to avoid any distortion/ discoloration /damage to the finished items.
 - viii. Wood work faces /parts coming in contact with masonry shall before shifting to the site be given a heavy coat of alkali resistance bitumen paint. Steel items coming in contact with other incompatible materials shall be given a thick coat of zinc chromate primer.
- G. **Glazing:** Glazing shall be done with flawless sheet glass of best approved quality without waviness, distortion, coloration / discoloration, of specified thickness in sizes as shown in the drawings, fixed as required with special glazing clips, putty, neoprene/PVC gaskets. All glass shall be cleaned thoroughly before they are fixed in position. Unless otherwise specified the minimum thickness shall be 5 mm thick.

9. **FIRE CHECK DOORS:-**

A. **General:-**

- i. The door shall be procured from approved manufacturer of CPWD / CBRI. The fire and smoke / hot gases check door shall be conforming to IS-3614 (Part-II)). The manufacturer shall have a prototype door tested and certified by CBRI Roorkee, of 120 minutes fire rating confirming to BS : 476 part 22 & IS : 3614 Part II .
- ii. The fire and smoke / hot gases check door shall not collapse during the rated period of the fire under the specified fire conditions.
- iii. The fire and smoke / hot gases check door shall not allow the passage of hot gases or the flames through the rebate of the gap between the door frame and shutter or through the holes, developed in the shutter during fire.
- iv. **Material:** -Door frames and shutter shall be made from materials specified in the bill of quantities.
- v. **Shop drawing:-** The contractor shall submit including required designing shop drawing for doorframes, shutters complete with
 - a. Plan, elevation with relative position of adjacent works
 - b. Glazing details with type size and fixing
 - c. Fitting and fixtures with type size, brand and fixing details.
 - d. Finishing details.
- vi. **Sample Approval:-** A sample of fire check door including fittings and fixtures, shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication

B. **Wooden Fire Doors & Frames**

- i. **Door Frames:** - Door frames shall be manufactured from 2nd class teakwood (Ivory Coast) of section as per BOQ. It shall have heat activated intumescent fire seal strip of size 20mm x 4mm (for smoke seal) of approved make provided in

grooves on all three sides of the frame. The frame shall be coated with one coat anti-termite fire retardant primer of approved brand. The frame shall be fixed with 8 nos. 100mm dia metal dash fasteners of approved brand and manufacture or as per direction of Engineer-in-charge.

ii. **Door Shutter:-**

1. The Door shutter shall be of thickness 50 mm minimum but not more than 55mm or as per BOQ, suitable for mounting on the door frame. It shall comprise of two non-combustible boards 12mm to 18 mm thick sandwiching 20 mm to 25 mm fire resistant insulation filler veneered with 3mm thick commercial ply on both faces and pasting of minimum 1 mm thick laminate over wooden fire of approved brand a 100% without Asbestos, Bructile and meerscham, having density not more than 1150 kg/m³ and thermal conductivity 0.14 W/m K with heat activated intumescent fire seal strip of size 20mm x 4mm of approved mounted in the grooves of teakwood lipping on all sides except bottom.
2. The intumescent sealant shall be used to fill the gaps between board and internal wooden lipping.
3. Vision Panel:- Vision Panel shall be rated vision panels with 6mm thick clear glass (2 hours fire rating) made from Spin turned Rings (380mm dia circular vision panel) or press formed (300mm Square vision panel). Glass shall be fixed with glazing gasket of self-sticking ceramic glass fiber having a classification temperature of 1260° C.

iii. **Finish:** - The door frame and door shutter shall be finished with minimum to coats of thermo setting acrylic paint for scratch resistance and durability on hard wooden surface (@3.5 sq.mtr. per ltr., per coat) including preparation of base surface as per recommendation of manufacturer to make the surface fire retardant. The paint shall be of approved brand and quality.

iv. **Ironmongry Hinges:** - Stainless steel ball bearing butt hinges, 3mm thick shall be fixed flushed to the frame and shutter.

C. **Metal Fire Doors & Frames:** - These shall conform to the BOQ and CPWD specifications.

D. **Fire Doors & Fittings**

All work is to be carried out in accordance with relevant IS Code and specification for Fire Door & fitting as per IS: 3614 (Part I) – 1966 and direction of Engineer in charge. Door shall be fixed with fire rated hinges 5 Knuckle, 2 bearing butt hinges size 4" x 3" x 3mm, in SS 304 and in satin stainless steel, as per EN 1935, CE Marked.

- i. **Mortice Lock:** - 2 hrs, fire rated mortice lock with lever handle tested in accordance with BS: 476 Part 22.A minimum one year warrantee shall be provided. Mortice sash lock with internal thumb turn and external key operation with lever handles shall be provided.
- ii. **Flush Bolts (For Double Door):-** 300mm concealed extended lever action flush bolts satin finish, fixed to top and bottom of the inactive blade shall be provided.
- iii. **Automatic Door Closer:** - Dual adjustable speed automatic door closer with rack and prinion method, in conformance with BS:476 Part 22 (for fire rating) and BS EN1154 shall be provided. The door closer shall have minimum of one year warrantee.

- iv. **Pull Handle:** 300mm long stainless steel grade 304 D type pull handle shall be fixed with necessary screws etc. complete. A minimum one year warrantee for the product shall be provided.
- v. **Fire Rated Panic exit device:** - It shall be suitable for door weights upto 120kgs. The Panic bar as per door leaf (SINGLE LEAF/DOUBLE LEAF) shall consist of Main Panic Latch component, End Component, Push bar, Striker Kit, end caps in Silver finish. Complete set with screws & fixing accessories, External trim, having fire rated door closer TS 71/68 rack and pinion door closer EN size 3/4, with std. arm and with two independent closing valves and latching speed adjustable by arm. Full plastic cover. Silver finish. As per EN 1154 life cycle 500,000 with seals and door stopper. The device shall be complete in all respect and fixed as recommended by the manufacturers. A minimum one year warrantee for the product shall be provided.
- vi. **Smoke Seals:** - Heavy duty smoke seals for smoke check doors shall be provided.
- vii. **Acoustic Seals:** - Acoustic seals of appropriate design duly fixed in shutter as well as door frame shall be provided.
- E. **Opening Width:** - Opening width of door mentioned in the drawings shall be width measured with both door shutters fully open in straight position.
- F. **Measurement:** - The measurements shall be done as per BoQ.
- G. **Testing:** - The Engineer – in - charge holds the right to get the door tested for fire rating at the cost of the contractor/vendor. In case the Engineer-in-charge desires to get the doors tested, then one door shall be selected at random out of the entire lot and shall be tested for two hour fire rating. The testing shall be got done from either CBRI, Roorkee or from any other laboratory approved by the Engineer-in-charge. The cost of material for testing and transportation / packing & other incidental testing charges shall be borne by the contractor. In case the door fails to meet the requirement, the entire lot shall be rejected.
- H. **Rates:** - The rates shall be inclusive of all material, T&P, Labour, etc. complete including the cost of fittings, testing etc. as described above.

10. GLASS ENTRANCES AND GLAZING WITH PATCH FITTING

A. GENERAL

- i. The contractor shall be responsible for design, fabrication, supply, installation, test and guarantee of all items including taking all measures that may be required to complete the work as per Architectural concept drawings and specifications details.
- ii. The specialist agency engaged to carry out the external glazing installation and supply shall have at least 5 years of relevant experience and have completed external glazing systems of similar nature and equivalent scale of works as shown in the tender documents.
- iii. The specialist contractor shall submit an outline of recent comparable works (illustrated by appropriate drawings, sketches, photographs, brochures) by the firm / its technical partner to illustrate the competence, experience and suitability of the firm.

B. The scope of work shall include:

- i. Design, preparation of shop drawings, calculations, engineering data and test reports.

- ii. Fabrication and installation of Glass Entrances and Glazing with Patch Fittings system.
- iii. All anchors, fixings, attachments, reinforcements, steel reinforcing for mullions and transoms required for a complete installation, except those specifically indicated as being provided by other trades.
- iv. Exposed Architectural mullions and other support members.
- v. Finishes, protection coatings and treatments.
- vi. Sealing with approved sealants within and around the perimeter.
- vii. All thermal insulation, firesafing etc. including supports and/or backing.
- viii. All caulking, sealing, electrometric and metal flashing, and gaskets including sealing at junctions with roof, ground-floor waterproofing and building expansion joints between structures.
- ix. Electrical bonding and earthing of all metal cladding elements.
- x. Provisions to receive electrical outlets and cutouts for conduits and other electrical work.
- xi. Glass and glazing.
- xii. Transportation, storage, handling, protection and cleaning.

C. SUBMITTALS

- i. Product Data: Include construction details, material descriptions, dimensions of individual components, profiles and finishes.
- ii. Shop Drawings

D. Fabrication and installation details, including followings

- i. Plans, elevations and sections.
- ii. Details of fittings and glazing.
- iii. Hardware quantities, locations and installation requirements.
- iv. Sample for verification, for each type of exposed finish required for
 - a. Metal finish: 150mm long section of patch fittings, rails and other items.
 - b. Glass: 150mm square, showing exposed edge finish.

E. MATERIALS

- i. Glass
 - 1. Glass shall be as specified in drawing or BOQ or as per design requirement. It shall be Indian / imported hard coated reflective bronze and heat strengthened glass. It shall be of approved make.
 - 2. In toughening of Glass, rolling direction shall be parallel to the width of the glass panel such that waviness if any is parallel to the horizontal and no waviness parallel to the vertical and to ensure that such waviness is of negligible order.
- ii. Components
 - 1. Patch fittings: Stainless steel clad aluminium
 - 2. Floating Transom Bar: Steel clad in metal matching fittings and in sizes recommended by manufacturer for application indicated. Include stainless

steel support rods, lateral adjustment and ceiling channel. Support fins to be metal, finished to match transom bar.

3. Rails: Stainless steel clad aluminium.
4. Accessory Fittings : Matching with patch fittings and rails metal and finish for overhead door stop, Centre hosing lock, glass support fin brackets and other as shown in drawing.
5. Anchors and fastenings: Concealed
6. Weather stripping: Sweep type

iii. Hardware

1. Hardware should be heavy duty in matching finish
2. Concealed Floor Closer and Top Pivots
 - a. Centre hung; BHMA A156.4, Grade 1; including cases, bottom arm, top walking beam pivots, plates, and accessories required for complete installation.
 - b. Swing : Double acting; Positive dead stop, concealed with hold open angle
 - c. Delayed action closing
 - d. Concealed Overhead Holder: Grade 1, with dead stop setting coordinated with concealed floor closer.
 - e. Push-pull set : Stainless steel finish
3. Lock set of approved make.

F. FABRICATION

1. Provide holes and cutouts in glass to receive hardware, fittings, rails and accessories before tempering glass. Fully temper glass using horizontal (roller-hearth) process and fabricate so, when installed, roll wave distortion is parallel with bottom edge of door or tile.
2. Factory assembled components and factory installed hardware to greatest extent possible.

G. EXECUTION

1. Examine areas and condition for compliance with requirements for installation tolerances and other conditions affecting performance of work.
2. Install all glass system and associated components according to manufacturer's written instructions.
3. Set units in level and plumb.
4. Maintain uniform clearances between adjacent components.
5. Lubricate hardware and other moving parts according to manufacturer's written instructions.
6. Set, seal and grout floor closer cases as required suiting hardware and substrate indicated.

H. CLEANING

1. The Contractor shall ensure that all actions are taken during installation to eliminate the effects of corrosive substances on the finishes.

2. The Contractor shall clean both internal and external surfaces to remove corrosive substances, dust or cement / mortar dropping during the installation as may be directed and instructed by the Engineer – in - charge.
 3. The internal surfaces of glass and aluminum frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.
 4. The Contractor shall provide written verification that cleaning agents are compatible with aluminum, stainless steel, glass coatings, granite, glazing materials and sealants. In no case shall alkaline or abrasive agent be used to clean the surface. Care shall be taken during cleaning to avoid scratching of the surface by grit particles.
 5. Prior to snagging inspections the Contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all glass and aluminum.
 6. The Contractor shall also make good any physical damage to the structure including scratches, dents, abrasions, pitting, etc. to the satisfaction of the Engineer – in - charge.
 7. Manufacturer's delivery or job markings on glass and adhesive for manufacturer's labels shall be either a neutral or slightly acidic material. In no case shall such material be alkaline; any staining of glass by alkaline material will be cause for rejection of the glass.
 8. After the installation of each pane of glass all markings and labels shall be carefully and completely removed from the panes. Thereafter no markings or labels of any sort shall be placed on the glass.
 9. Glazed openings shall be identified by suitable warning tapes or flags attached with a non-staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall not be in contact with glass.
 10. As soon as it is practically possible after the issuance of the occupation Permit for the Building, the Contractor is to carry out a complete cleaning of the external face.
- I. PERFORMANCE GUARANTEE: The contractor shall offer a minimum of 10 year Performance Warranty for the entire installation carried out.
- J. MEASUREMENTS: - Measurements shall be in Sq m of actual area covered.
- K. RATE: - Rate shall include all required labour, material, designing, drawing conveyance, testing at approved laboratory breakage, wastage, supervision, protection till handing over etc. complete.

11. FLOORING:

- a. The flooring in the building shall be as per the approved floor finish drawings and laid in such a way that limits in floor levels would not exceed the limits provided in the latest CPWD specifications or manufactures specifications.
- b. Wherever Vitrified Tile flooring is done, it shall be with multy grade/range 1st Quality tiles.
- c. Slope in floors shall be provided as per architectural drawings, else the levels at any place when checked over a distance of one meters in any direction should not show variation in floor level more than 3 mm.

- d. Rate for the items of flooring is inclusive of provision of sunken flooring and finishing edges of the same in bath kitchen, toilets, cutting holes for traps/ pipes etc., and nothing extra shall be paid on this account unless otherwise specified.
- e. Protective layer to be provided of any type of flooring and nothing extra shall be paid on this account.

12. Polycarbonate Sheet Roofing

- a. The polycarbonate sheet roofing shall be of Lexan of GE Plastics or equivalent approved make and shall conform to manufacturer's specifications. It shall conform to BIS Standards IS 14443:1996 with latest update. The contractor shall procure the sheets from the manufacturer as per the approved list. The material procured shall be free of any defects and damage to the edges, surface etc. The defective material shall be replaced by the contractor of his own cost. The contractor shall ensure that the material is procured and delivered at installation site without any damage.
- b. Adequate care shall be taken for protection of the material before installation as well as afterwards till handing over the building for occupation. The contractor shall ensure careful handling and storage and prevent any rough handling, to prevent any edge or surface damage. Any panel with edge damaged or damage to the finish etc. shall not be allowed to be used in the work and shall be replaced by the contractor at his own cost. The contractor shall procure the material including providing for wastages, damages etc. in one lot so as not have any color and shade variation. Atleast one sample of the polycarbonate sheets brought by the contractor to the site of work shall be tested. The test shall be got done at reputed independent laboratory as approved by the Engineer-in-Charge. However, the contractor shall obtain and submit to the Department the manufacturer's certificate for compliance of the polycarbonate sheets as per the manufacturer's specifications and also copy of the manufacturer's test report for the record.
- c. The polycarbonate sheet shall be multi-wall (twin wall) section with thickness of the sheet not less than 16mm and the thickness of the walls on the two external faces not less than 0.8mm each. The sheet shall be extruded from polycarbonate material and shall have homogeneous composition of the material. The sheet shall have co-extruded UV protective layer. The sheet shall be fixed with the face treated for UV resistance, upward/exposed to sunlight. The weight of the sheets shall not be less than 1.7 Kg per sq.m. Light transmission shall be above 35%. The sheets shall be obtained with closed edges. The sheet shall be bent (if required) to the require profile as per the architectural drawings but with radius not less than 175 times the thickness of the sheet. The sheet shall be fixed in a manner that the cells are parallel to the span of the shed.
- d. The polycarbonate sheets shall be of colour and shade as approved by the Engineer-in-Charge.
- e. The physical and the chemical characteristics of the polycarbonate sheets shall be as per the manufacturer's specifications and shall conform to the ASTM standards. The sheets shall conform to BS 476 part 7 for the fire rating. The contractor shall submit written guarantee to the Engineer-in-Charge for the polycarbonate sheets procured and provided by him against any defects like peeling, breakage, fading of color/ discoloration, cracking, leakage through the roofing loss of strength etc. for a period of ten years after the date of completion of the work. The contractor shall obtain similar back-to-back guarantee from the manufacturer. The strength requirements are as specified below:
- f. Distribution load: 800 N per sq.m.

- g. The polycarbonate sheets shall be used in one piece along the span of the temporary sheds. The width of the sheet across the span of the shed shall not be more than 700 mm. The polycarbonate sheets shall be bent to required profile (linear or curvilinear) as per the architectural drawings and fixed in position, to the structural steel framework, using self-driving self-tapping screws with EPDM washers etc. The sheets shall be secured to the structural steel framework so as to withstand all the design dead, live, wind, other accidental loads etc. and shall be fixed in a workmanlike manner. It shall not have any sag. Therefore the fabrication work shall be got done through experienced & reputed fabricator, to be got approved from the Engineer-in-Charge. The contractor shall submit to the Engineer-in-Charge the shop drawings giving fixing details for the polycarbonate sheets in roofing and also quality assurance and methodology statement for the item. The polycarbonate sheets shall be jointed along the length of the shed using aluminum top & bottom pressure plates having required profiles for fixing the EPDM gaskets, screws, washers etc. The aluminum pressure plates shall be color anodized or powder coated to the require shade. The joints in the sheet shall be provided only on the RHS steel sections of the framework and shall not be permitted elsewhere. The joint width of about 3-4 mm may be provided between the sheets at the junction for thermal expansion. The EPDM gaskets of the required profiles shall than be fixed in the grooves in the aluminum pressure plates on either side of the joint in the polycarbonate sheet. The bottom aluminum plate shall be fixed to the structural steel framework using self-driving self-tapping screws; washers etc. (one screw fixed to each sheet) and the screws fixed @300 mm center to center along the span of the shed.
- h. The EPDM gaskets of the required profile shall be fixed in the grooves in the aluminum pressure plate on either side of the joint in the polycarbonate sheet. The top aluminum pressure plate shall than be fixed securely to the bottom aluminum plate using countersunk self-driving self-tapping screws, EPDM washers etc. All the screws shall be concealed using structural silicone sealant DC 995 of Dow Corning or equivalent approved brand. Also, wherever required (especially at the joint in the EPDM gasket etc.) the junction of the polycarbonate sheet and the sides of the pressure plates on both sides shall be sealed using structural silicone sealant DC 995 of Dow Corning or equivalent brand as approved. The item includes cost of all the operations and all inputs of the material [including Polycarbonate sheet, EPDM gaskets, anodized aluminum capping, anodized aluminum edge capping to the sheet with U-shaped EPDM gasket, all structure silicone sealant, self-driving self-tapping screws with EPDM washers, nuts, bolts, washers etc. and the like, labor, T & P, all the incidental charges, wastages etc. involved in the work. However for the purpose of payment only the actual area of the polycarbonate sheet provided and fixed in position shall be paid for separately under relevant item. The contractor shall maintain the roofing scratch and damage free till the handling over the building for occupation, at his own cost.]
- i. Tolerance:-
- | | |
|---------------|--|
| i. Weight | : 5% |
| ii. Length | : + 50 mm |
| iii. Width | : + 10 mm |
| iv. Thickness | : +/- 15 % upto and including 2 mm nominal |
| | : +/- 10 % above 2 mm |
- j. The polycarbonate sheets shall be obtained with protective films on both sides. Care shall be taken while fixing to fix the sheets with UV protected side exposed to outside. The sheet shall be stored in a manner not to expose to direct sunlight. The sheet shall be cut to the required size or drilled using the toothed blade/machine. After fixing the protective film shall be removed and the sheets cleaned using non-alkaline based

detergent and abrasive equipments or solvents be avoided. The silicones, gaskets, tapes etc. shall be compatible with the polycarbonate sheet.

- k. For joining the sheets, at least one complete channel width of each sheet shall be secured per sheet within the joining profile. Since thermal coefficient of expansion of the sheets is different from the RHS steel frames, suitable provision shall be made for accommodating differential expansions. Also any rigid jointing agent that may prevent thermal movements shall not be used. The required section aluminum profiles (upper central profile, lower central profile and top profile) for fixing the polycarbonate sheet to the structural framework as well as for joining the sheet shall be as per the manufacturer's specifications. The top capping profile shall be snap fit to the upper central profile, The EPDM gaskets and the screws shall be provided as per the manufacturer's specifications.
- l. The Gaskets shall be extruded micro wave/ steam cured EPDM/ silicone of approved quality compatible with substrates, finishes and other components they are in contact with. All gaskets exposed directly on the exterior face shall be silicon gaskets, which are UV resistant. They shall not degenerate/discolor or/each on exposure to weather/ rain/pollutants etc.

13. FALSE CEILING: -

- a. False ceiling items in general are carried out as per the description of the item in the Bill of quantities and also as per the manufacturer's specifications / as directed by the Engineer – in – Charge.
- b. Location of particular type of false ceiling shall be as per relevant drawing, in its absence written approval of the Engineer – in - charge shall be obtained.
- c. The false ceiling tiles from manufacturers using recycled materials shall be preferred.

14. UNDER DECK INSULATION

- a. **Material:-**The under deck insulation shall be with Glass Wool Insulation Board. The Glass Wool Board shall conform to following specifications.

GLASS INSULATION WOOL BOARD (GREEN BUILDING)			
	Test Parameters	Standard Value	Tolerance
1	Physical Test		
a	Visual Appearance		
b	Shots Content	Free from Shot Content (Tested as per IS : 8183)	
c	Dimensions		
	i. Length	1200 mm	+20 mm/ -10 mm
	ii. Width	600 mm	+10 mm/ -10 mm
	iii. Thickness	100mm	+5 mm/ -5 mm
d	Bulk Density	48 Kg/M ³	± 15%
e	Hydrophobic / Non Hydrophobic Behavior (Tested as per Is – 8183 / 3144)		
	i. Moisture Content	2.0% Max	
	ii. Moisture Absorption	2.0% Max	
f	Incombustibility	Incombustible When Tested As Per Is 818 / 3144	
g	Recovery after Compression	90% Min. (Tested As Per Is -8183)	
2	For Long Life Functionality / Dimension Retention / Rigidity		
a	Loss on Ignition (Binder Content)	Av. 7% Minimum when evaporated at 550 ± 50 till yellow & black colourless fiber	

		achieved	
b	Jolting Test	Height settlement not more than 3.0% in test as per IS: 8183/3144	
c	Vibration Test	Height settlement not more than 1.0% in test as per IS: 8183/3144	
d	Recycled Content	25% External Cullet 10% Internal Cullet 7% Trimmed Waste	
3	Chemical Test :- Resistance To Corrosion Attack		
a	Chloride Content %	0.01% max. (tested as per IS: 8183)	
b	Alkalinity	Ph- 7.0 – 10.0 (tested as per IS: 8183)	
c	Odour Emission Test	No apparent difference in odour (tested as per IS: 8183- 1993)	
4	Type Test		
a	Thermal Conductivity	0.3 w/m k (At 25 dg. C mean temp.)	

B. Installation Guidelines:-

- i. The insulation board to be fixed to hold against the RCC true ceiling.
- ii. For fixing drill RCC slab through the insulation at 1200 mm x 600 mm centres.
- iii. Apply the Hilti make IDP- 6/8 polyamide fasteners (110 mm in length) or equivalent with the help of hammer to the drilled points.
- iv. All the edges of the boards placed side by side to be sealed with 50 mm wide self-adhesive white HDP tape.
- v. The above insulation system can be concealed under false ceiling system if required.

15. ALUMINIUM COMPOSITE PANELS (ACP) CLADDING

- a. Scope of Work includes providing and fixing Aluminium Composite panel cladding including framing as per the elevation, section and the plan drawings provided, fabricated out of heavy duty Aluminium extruded profiles conforming to alloy 643900 WP with chemical composition and mechanical properties as per IS-733 and as per specifications. The scope of work shall be read in conjunction with the specification of curtain walling / structural Glazing System.
- b. The contractor shall design, supply, fabricate, deliver and install and guarantee all construction necessary to provide a complete aluminium composite panel cladding, complete with all necessary anchors, hardware and fittings to provide a total installation, fully in conformity with the requirements and intent of the drawing and specification as per item description.
- c. The contractor shall design the cladding as per the prevalent site conditions and building elevations profiles. The design parameters shall be in conformity the structural glazing system. No extra claims shall be entertained at any stage for aluminum profile/ wall thickness and size dimensions.
- d. The anchoring / bracing of the wall cladding to the RCC beams/ columns shall be done with non-corrosive galvanized brackets of approved design, (Galvanizing to be done conforming to IS 4759-1996 up to 610 gms. Per Sq. M. (80- 90 micron thickness).

- e. The framework shall be aligned for the entire height of each Mullion and of the entire width of each Transform by laser beam equipment to ensure 100 percent 'X' axis and 'Y' axis alignment.
- f. The system should also provide for pressure equalization. The details for pressure equalization to be submitted by the contractor and got approved by the Engineer-in-charge.
- g. EPDM Gaskets of suitable profiles (to accommodate shall be provided including the labour element for fixing in appropriate locations is to be included in the rate).
- h. The Periphery of the framework shall be sealed both from inside and outside with silicon weather sealant to make the cladding watertight.
- i. Cost of Aluminium composite panel consisting of a core of polyethylene sandwiched between two aluminium skins of 0.5mm thickness with a mild edge. 4 mm total thickness with surface finish of PVDF coating as approved by the Engineer-in-charge, as shown in the elevation, plan and cross section drawings along with labour element for cutting stacking, carrying to heights and fixing to appropriate locations is included in the rates.
- j. All the vertical and horizontal section grooves are to be sealed non staining silicon sealant of make as specified in the list of approved make to make the entire system synchronies with the basic structural glazing/curtain wall structure and also make the system air tight and watertight. The fixing details should be got approved by the Engineer-in-charge. The peel off foil should be removed at the time of handing over as may be required by the Engineer-in-charge.
- k. Any joint provided between cladding elements to cater for individual panel installation and shall be sealed off with extruded EPDM gasket or silicon sealant.

l. Product

- i. ACP shall be as approved with high fibre filled sandwiched panel 4mm install on Aluminium framing and Galvanised brackets. Aluminium cladding panel to be PVDF fluorocarbon coated factory applied colours. Reverse side to be in mill finish. All the joints shall be sealed with silicon sealant of approved make. The colour of sealant to be decided by Engineer-in-Charge.
- ii. A sample of panels and installation methods to be submitted to the Engineer-in-Charge for approval.

m. Manufacture

The panels must be visually flat. Any stiffener applied to compensate for wind load must not read through.

n. Installation

The panels shall be fixed in accordance with manufacture's recommendations.

o. Technical Properties of Aluminium Composite Panels

A	Composition	4.0 mm thick aluminium composite panel comprising of high mineral filled core sandwiched between two skins of aluminium alloy, Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene.
B	Dimensions	Panel thickness : 4mm
C	Tolerance	Width \pm 2.0mm Length \pm 4.0mm

		Thickness + 0.02mm
D	Principal Properties	Panel weight: 5.5 kg/sq.m Thermal expansion: 1mm/M/60 deg.C. Moment of Inertia: 0.347 cm ⁴ /m
E	Acoustic Properties	Average airborne sound transmission loss R/N 25db (DIN 4109)
F	Mechanical Properties	Tensile strength ≥ 130 N / mm ² 0.2 % proof stress 90 N / mm ² Elongation 5 % Modules of elasticity 70,000 N/mm ²
G	Thermal Transmittance	R = 0.014 m ² °C/W
	Finish	PVDF stove lacquered (Fluoro carbon) on one side and reverse side in mill finish.
	Colour	Colour to be selected by Engineer-in-Charge using standard PVDF colour chart from manufacturer.
	Panel size: Width	1000/1250/1500mm
	Length between	1500 and 5000mm
	Aluminium Extrusions	Extrusions shall be of aluminium alloy 6063 T5, conforming to BS-1470 – 1475: 1972 in mill finish.

- p. **Protection:** The finished surface shall be protected with 80 microns self-adhesive Peel Off film with two layers of white and black tested to withstand at least 6 months exposure to local weather condition, without losing the original peel off characteristic or causing stains or other damages. Protection should not be removed until after installation.
- q. **Warranties;** The Contractor shall provide a data to confirm compliance with specific requirements for resistance and fire properties. The guarantee should be for a 20 salt spray resistance and fire properties. The guarantee should be for a 20 year period against peeling chalking (No. 8 rating), fading, blistering, flaking, chipping and cracking.
- r. **Measurement:** The measurement shall be for exposed actual surface area with grooves cladded on plain/ curved surface excluding the concealed trims.
- s. **Technical Data: -** The technical data provided hereunder is for guidelines. The data, specific for the site location, shall be got approved by the contractor from the Engineer-in-Charge for the design of the ACP and structural Glazing System.
- i. **Design Wind Loading**
 - a. 850 N/m² positive and negative to Podium.
 - b. 1150 N/m² positive and negative to Tower.
 - c. 1500 N/m² positive and negative to Crown to Tower.

No cladding element shall sustain permanent deformation of failure under loading equivalent 1.5 times the design wind pressure specified.
 - ii. **Deflection**

Deflection of any aluminium frame shall not exceed 1/175 of the clear span.
 - iii. **Expansion and Contraction**

The cladding shall be so fabricated and erected as to provide for all expansion and contraction of the components. Any temperature change due to climatic conditions shall not cause harmful buckling, opening of

joints, undue stress on fastening and anchors, noise of any kind or other defects.

iv. **Flatness**

The cladding surface taken individually shall not have any irregularities such as oil canning, waves, buckles and other imperfections when viewed at any position but not less than at an angle of 15 degrees to the true plane of the panel with natural lighting of incident of not less than the same angle.

v. **Water Tightness**

The panel cladding shall be so constructed to be water tight with provision for rear ventilation.

vi. **Acoustic Treatment**

The cladding panel system shall be designed so as to dampen noise caused by splashing water.

B. Fixings

- i. Fasteners including concealed screws, nuts, bolts and other items required for connecting aluminium to aluminium shall be of non-magnetic stainless steel.
- ii. Rivets used for fastening panel to aluminium sub-frame shall be of alloy aluminium large flange head type with stainless steel mandrel.
- iii. All fixing anchors, brackets and similar attachments used in the erection shall be of aluminium or non-magnetic stainless steel.

C. Weather seal

- i. All exposed joints between panels which are required to be water tight, shall be sealed with extruded EPDM gasket of hardness approx. 75 SHORE.
- ii. All secondary weather seal shall be of self-adhesive tape as approved by the Engineer-in-charge.

16. STRUCTURAL GLAZING SYSTEM

A. SCOPE OF WORK

- i. The contractor shall design, engineer, test, fabricate, deliver, install, and guarantee all construction necessary to provide a complete structural glazing system to the proposed building, all in conformity with the Drawings as shown. Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the Drawings and/or without limiting the generalities of the foregoing, the structural glazing Systems shall include, without being limited to, the followings:
 - a. Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings metal closure, windows etc.
 - b. All anchors, attachments, reinforcement and steel reinforcing for the systems required for the complete installations.
 - c. All thermal insulation associated with the system. All fire protection associated with the system.

- d. All copings, end closure and metal cladding to complete the system.
- e. All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.
- f. Isolation of dissimilar metals and moving parts.
- g. Anticorrosive treatment on all metals used in the system. Polyester powder coating aluminium sections.
- ii. The contractor shall also be responsible for providing the followings:
 - a. Engineering Proposals, Shop Drawings, Engineering data and Structural Calculations in connection with the design of the structural glazing System.
 - b. Scheduling and Monitoring of the Work.
 - c. Mock-ups, samples and test units.
 - d. Performance testing of the structural glazing framing and glazing assembly.
 - e. Co-ordination with work of other trades.
 - f. Protection.
 - g. All final exterior and interior cleaning and finishing of the structural glazing System
 - h. As-built record drawings and photographs.
 - i. Guarantees and Warranties.
 - j. All hoisting, staging and temporary services.
 - k. Conceptualising and design of a suitable maintenance system for structural glazing.
- iii. The water tightness and structural stability of the whole structural glazing System are the prime responsibility of the Contractor. Any defect or leakage found within the Guarantee Period shall be sealed and made good all at the expense of the Contractor.
- iv. The structural glazing 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.

B. BUILDING REGULATIONS

Structural glazing shall comply with all Government Codes and Regulations including IS codes, if any.

All structural glazing, individual aluminium and glass components and all completed work shall be designed and erected to comply with the following:

- i. Design load and deflection.
- ii. Structural glazing construction in its entirety shall be fabricated and erected to withstand without damage or permanent deformation inward (positive) and outwards (negative) pressure, all acting normal to the construction plane with a maximum deflection of not exceeding 1/175 of the clear span between structural support or 20mm

maximum whichever is less.

- iii. Structural performance of all parts of structural glazing system shall conform to relevant IS codes, wind load as per IS-875 and seismic loads as per IS-1893. Deflection shall cause no permanent set in excess of 1/1000 of span nor evidence of structure failure.

iv. **Design Wind Loading**

- a. 850 N/m² positive and negative to Podium.
- b. 1150 N/m² positive and negative to Tower.
- c. 1500 N/m² positive and negative to Crown to Tower.

No cladding element shall sustain permanent deformation of failure under loading equivalent 1.5 times the design wind pressure specified.

C. **MEASUREMENTS**

Measurements of the structural glazing shall be in the metric system in sq.m correct to two places of decimal. The area considered for measurement shall be net area as fixed on the exterior face of the structural glazing including open able windows as part of structural glazing. The contractor shall be responsible for verifying all the dimensions and actual conditions on site.

D. **RATE**

The rates shall include the cost of all the operations described above including the cost of all materials, labour, design, fabrication, erection, finishing, scaffolding and testing of water tightness etc.

E. **TENDER DRAWINGS AND SPECIFICATIONS**

The tender drawings indicate profile and configuration required together with relationship to structural frame and interior building elements.

The Specification and tender drawings is of the performance type and includes only the minimum requirements of the /structural glazing Wall System without limiting the Contractor to the method of achieving desired performance.

F. **POST TENDER REQUIREMENTS**

i. Design Proposals

The contractor shall propose the final design in such a way that all basic functional and architectural requirements are fulfilled and get the same approved by Deptt. However, basic design requirements as described in the specification and other Architectural requirements such as the size of window, net glass area, ventilator, configuration of windows and spandrels shall be retained.

The design proposals shall be in the form of drawings, drawn to full scale as far as practical and specification shown in or describing all items of work including:

- a. Request details as indicated on the tender drawings.
- b. Metal quality, finishes and thickness.
- c. Glass quality, coating and thickness and proposed manufacturer's brand names.
- d. Sections of the mullion and transom together with structural

calculations.

- e. Arrangement and jointing of components.
- f. Field connections especially mullion to mullion and transom to mullion.
- g. Fixing and anchorage system of typical wall unit together with structural calculations.
- h. Drainage system and provision in respect of water leakage in the curtain wall/structural glazing system.
- i. Provisions for thermal movements.
- j. Sealant and sealing method.
- k. Glazing method.
- l. Wind load and seismic load and any other specific load considered in the design.
- m. Lightning protection link-up system of the curtain wall/structural glazing for connection and incorporation into the lightning conductor system of the building. Design concept must be stated in the proposal.

The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case this tolerance exceed those specified in the Specification.

Any parts of the curtain wall/structural glazing, when completed, shall be within the following tolerances:

Deviation from plumb, level or dimensioned angle must not exceed 3mm per 3.5m of length of any member, or 6mm in any total run in any line.

Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle, must not exceed 9mm total at any location.

Change in deviation must not exceed 3mm for any 3.5m run in any direction.

ii. Samples

The contractor shall also submit samples of mullion and transom sections in lengths of 300mm with the same finish and workmanship along with the proposals and 300mmx300mm samples of glass (samples to include exposed screws and other exposed securing devices, if any).

iii. Preliminary Programme

The tenderer shall also submit a preliminary programme of the contract works showing the various stages of design sampling, testing, fabrication, delivery and installation of the works.

- iv. Upon approval of the shop drawings, at least 4 copies shall be submitted by the Contractor.
- v. The Contractor/Sub-contractor shall submit a maintenance manual for the curtain wall/structural glazing system inclusive of all metal parts, glass and finish etc.
- vi. During detailed design and execution any details may increase as per actual requirement at site, these variations shall be executed without any extra cost implications to the HLL.

G. EXECUTION- Performance Testing

The performance tests are to be conducted on the structural glazing system, if the area of the structural glazing system exceeds 2500 Sq.ms from the certified laboratories accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories), Department of Science and Technology, India. The decision of the Engineer-in-charge about the necessity of testing of shall be final and binding.

i. General Requirements

Mock-up units shall be constructed by the contractor and tested to determine the structural stability as well as air and water infiltration or leakage at glazing beads and all other joints designed into the façade.

After approval of structural calculations and shop drawings for the structural glazing, one (1) Test Unit for performance testing of the structural glazing shall be constructed by the contractor at a laboratory approved by the Department (Refer BOQ).

Erect mock-up under manufacturer's/installer's direct supervision and employ workmen as they would be employed during the actual erection at the job site.

Test procedures test schedules and test locations shall be submitted to Engineer-in-charge for approval before testing.

Prior to fabrication of Test Units, the contractor shall submit shop drawings and calculations of the Test Unit for the Engineer-in-charge's approval.

Production for final job site erection shall not start until approval has been obtained as a result of the mock-up test.

ii. Test of Wind Pressure

The equivalent load of wind pressure or wind suction shall be given to the Test Unit as increasing or decreasing the inside pressure in the 'Pressure Chamber' at which the Test Unit is fixed.

The static wind pressure shall be applied up to 1.5 Kpa at maximum wind pressure. The variation of dynamic pressure shall be of any approximate sine-cure-line.

Deflection on each observational points of the Test Unit shall be observed and recorded under the Static pressure as described above.

Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.

The deflection on the main structural parts in these conditions shall not exceed:

- a. $1/175$ of the span between supports or 20mm, whichever is the lesser for vertical elements.
- b. $1/250$ of the span between supports for horizontal elements.

The extent of recovery of deformation 15 minutes after the removal of the test load is to be least 95%.

iii. Test of Lateral Deflection per Floor Height

Lateral deflection per floor height shall be occurred on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

The deflection of every + 2.5mm shall be increased upto + 13mm on the Test Unit (Static Deflection Test).

The dynamic deflection shall be applied upto + 13mm.

The variation of dynamic deflection shall be of an approximate sine-curve-line, one period of 3 seconds.

The dimension of the deflection on each observational points of the Test Unit shall be measured under the condition as described above, the damage shall be observed.

Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall/structural glazing except sealant at maximum deflection.

iv. Test of Water-tightness

Water shall be sprinkled to the Test Unit under the wind pressure. Pressure shall not be applied to the Test Unit.

The volume of the sprinkling water in one minute shall be 5 litres/m² min. (0.1 gal/ sq.ft.).

All water leakage and drainage system at the joint and openable sash of the curtain wall/structural glazing system shall be observed from the outside of the chamber.

Hold the test 2 times, in sequence as described below, conforming to the above mentioned conditions.

Install the test unit.

Hold 1st water-tightness test.

Hold test of wind pressure as described above. Hold 2nd water-tightness test.

Lateral deflection test.

Water leakage at all parts of the Test Unit shall not be observed inside during the 1st water- tightness test.

v. Test Report

The Contractor is required to submit five (5) copies of test reports to the Engineer-in-Charge.

vi. Cost of Performance Test

The Contractor shall allow in his tender for the cost of the performance testing and of fabrication, erection, corrections to and demolition of the Test Units including any special provision required in the testing laboratory for the tests mentioned above.

The Contractor shall allow for amendments and adjustments to the mock-up as required by the HLL.

If the Test Unit fails to pass the initial testing, the Contractor shall make the necessary corrections to the Test Unit and shall have to get the Test Unit retested by the Testing Laboratory till it passes the tests.

Cost of corrections to the Test Unit and cost of re-testing shall be borne by the Contractor at no additional cost to the HLL.

vii. Shop Drawings and Calculations for the Performance Testing

Prior to fabrication of Test Unit, the Contractor shall submit shop drawings and calculations of the Test Unit for Engineer-in-Charge's approval.

viii. Record Drawings

The testing laboratory shall keep copy of approved Test Unit shop drawings and calculations at testing laboratory during testing of Test Unit.

The testing laboratory shall accurately and neatly record on the above mentioned shop drawings all changes, revisions, modification etc. made to Test Unit, which shall become the record drawings.

At completion of testing and after approval of test reports the testing laboratory shall submit the marked-up record drawings to the Engineer-in-Charge.

ix. Contractor's Representatives

Full time attendance by Approved Representatives of the Contractor & subcontractor associated with the erection of curtain wall/structural glazing shall be provided for the erection of the Test Unit and for all testing of the Test Unit.

H. PERFORMANCE GUARANTEE

The tenderer shall provide a performance guarantee of requisite value to be indicated in the General Conditions of Contract for a period of five years, to provide for expenses, to cover the risk and cost of rectification of defect, noticed during the five years guarantee period. Guarantee period to start from the date of completion of the project.

17. STAINLESS STEEL RAILINGS

- a. The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the stainless steel railing till completion and handing over of the work.
- b. The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-in-Charge.
- c. The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns. The details of the joints in the stainless steel railing including location, etc. shall also be shown in the shop drawings.
- d. The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of Engineer-in-Charge / HLL. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge / HLL. The mock-up shall be dismantled and removed by the contractor as per the directions of the Engineer-in-Charge. Nothing extra shall be payable on this account.
- e. The stainless steel shall be of grade 304 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.

- f. The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade. Nothing extra shall be payable on this account.
- g. One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.
- h. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.
- i. The item includes the cost of all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T & P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.
- j. The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.
- k. The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of Engineer-In-Charge.

18. GLASS:

- a. All glass and glazing material shall be verified and coordinate with the applicable Performance requirement.
- b. All glass shall be cut to required size and ready for glazing. All glass shall be accurate sizes with clear undamaged edges and surfaces which are not disfigured. Any panel which does not fit any section of the curtain wall and shop front will be rejected and a replacement made at the Contractor's expense.
- c. Glass shall conform to the quality, thickness and dimensional requirement specified in US Federal specifications DD – G0415C.
- d. Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm within 260mm of leading or trailing edge, or 0.076 mm in centre. Direction of ripple shall be consistent and is acceptable to Engineer-in-charge. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be unidirectional and surface compression shall be in the range of 320-450 Kg/cm². All glass shall be delivered to site with the manufacturer's label of identification attached.
- e. The glass glazed panel / structural glazing frames for the structural glazing system shall be designed to withstand lateral imposed loads and comply with requirement of local building codes.

- f. Glass shall be free from defect or impurities detrimental to its performance. Defects such as bubbles, waves, spots scratches, spalls, discoloration, visibly imperfect coating, chipping, and bubbles delaminating of opacifier film shall be limited in accordance with the Manufacturer's / trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass should be consistent in colour.
- g. Double glazed units shall be procured only from approved manufacturer. Quality control tests shall be performed for mixing, curing, adhesion and dew point. The unit shall be guaranteed against condensation and dirt between the panes, failure of seal and damage to internal coating.
- h. All glass breakage caused by the Contractor or his sub-contractor because of negligence or caused by the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.

19. WATER PROOFING TREATMENT:

All the items for water proofing treatment with cement based water proofing treatment for roof slab and sunken portion in schedule of quantities shall be guaranteed for TEN YEARS the case of cement based treatment by the contractor as per Performa prescribed. The water proofing treatment work should be got done through specialized agency approved by EIC.

20. INTEGRAL CEMENT BASED WATER PROOFING TREATMENT FOR ROOF /SUNKEN FLOORS OF W.C'S ETC.

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

21. ANTIBACTERIAL PAINT

- a. The Antibacterial Paint shall be able to provide anti-Microbial Protection:
- b. The scope of work includes providing & applying approved makes anti-Microbial Paint on wall surfaces as per manufacturer's specifications complete in all respect & as directed by Engineer-in-charge. Following are the desired characteristic of the paint:
 - i. Protection: The product hygiene coatings to start the biocidal action as soon as the microorganism land on the surface, and prevents the growth of mould, bacteria and yeasts for at least 5 years.

- ii. Lily Cycle Savings: The unparalleled durability of hygiene coatings should help to extend the maintenance cycle and to minimize all related material, labour and shut down costs.
- iii. Chemical Persistence: The hygiene coatings should be highly resistant to abrasives, detergents and weak acids and alkalis used in cleaning regimes. Furthermore, they can be regularly steam cleaned without any loss of performance or adhesion to the substrate.

22. SEISMIC / MECHANICAL EXPANSION JOINTS

- a. The treatment of Seismic / mechanical expansion joints as per the schedule of quantities shall be carried out strictly as per the specifications mentioned herein. In the absence of specifications of any material, relevant I.S. specifications shall be followed and in case any material is not covered up in the specifications; Engineer-in-charge's instructions shall be followed. No deviation shall be permissible unless specifically approved by the Engineer-in-charge.
- b. The work shall be carried out as per CPWD specifications and directions of Engineer-in-charge.
- c. The work shall be carried out as per site requirement. The contractor shall submit detailed drawing/shop drawing for each type of joint within three days from the date of award and shall be got approved from Engineer-in-charge before execution of the work.
- d. The contractor shall make minor modification in the samples as per site requirement with the approval of Engineer-in-charge if required and nothing extra shall be paid for this modification.
- e. The contractor shall submit the test reports of the product of the manufacturers.
- f. **Manufactures:-** All seismic/mechanical expansion joints shall be designed and manufactured by the approved manufacturers.
- g. **Guarantee:-** All the joints shall be guaranteed at least for the period of 5 years when installed by the certified applicator in the prescribed performance.
- h. **Installation:-** Installation shall be in strict accordance with manufacturer's technical specifications, details and installation instructions. The work shall be carried out through the specialised agencies as approved by the Engineer-in-charge.
- i. **Protection:-** The system and its component should be protected during construction and after work is complete, the exposed surface and adjacent areas should be cleaned by suitable cleaner to the satisfaction of Engineer-in-charge.
- j. **Rates:-** The rate shall include the cost of material inclusive all taxes except VAT, excise and custom duty, freight charges, landing charges, insurance, transportation up to site and fixing of expansion joints including all screws, bolts, adhesive, scaffolding etc. as per requirements on all the floors.
- k. **Sample for joints:-** The agency shall supply sample of minimum one meter length of all types of expansion joints and the same shall be fixed at site at appropriate location and the same shall be approved by the competent authority which shall be duly intimated by Engineer-in-Charge. The agency shall place the order for procurement of mechanical expansion joint from the parent company for supply only after obtaining approval from Engineer-in-Charge.
- l. **Materials:-**

- a. EPDM (Ethylene Propylene Dinine membrane) water resistant membrane shall be of n.v.INTERBARIMA s.a., Belgium or equivalent make. The EPDM membrane shall be pasted with approved adhesive to the surface.
- b. S.S. screw shall be of canon or equivalent make approved by Engineer-in-charge.
- c. Aluminum sheet shall be of approved make and shall generally confirm to IS: 737-1986. The powder coating on aluminum sheet shall be 50-60 microns. The slots on the aluminum sheet shall be made by lath machine with smooth and uniform finish.
- m. For any discrepancy in item and corresponding drawing, the decision of Engineer- in-Charge shall be final and nothing extra shall be paid on that account.

23. TECHNICAL SPECIFICATIONS OF HERMETICALLY SEALED SLIDING LEAD DOOR:-

- a. Anti-Radiation Sliding doors are hermetically sealed doors with 2mm lead inside that comply with AERB requirements for X-Ray shielding Doors. Three sided wall frame consist of 2mm lead lining. These Doors should withstand up to 75 Pa Pressure. The door shall be procured from approved manufacturer and Door frames and shutter shall be made from materials specified in the bill of quantities.
- b. **Door Shutter:-**
 - i. Core of minimum 60mm thick doors consist of approved make and shade 4mm thick high pressure compact laminate on both sides, 2mm thick lead lining (Weight:- 24.4 Kg/ m²) with 99% pure lead & 50 mm thick CFC free high density, injected polyurethane puff (Density 40 kg/m³).
 - ii. The door provides noise insulation up to 28 db, door core to be provided with 2.5 mm thick high grade Aluminum Extrusion profiles on the edges of the shutter with necessary Screw & Fixtures.
 - iii. Shutter fixed with 3-tier EPDM sealing gasket (60 degree shore) on vertical sides & top side and 2-tier EPDM sealing gasket fixed on lower part of door shutter to ensure perfect hermetic sealing.
 - iv. Stainless steel 304 wheel chair combined with self-lubricating rollers fitted on double ball bearings on top of shutter. The single length aluminum track to be provided and fixed for sliding door over it which can withstand the load of the door shutter.
- c. **Vision Panel:** - A 10 mm thick of 305 mm x 305 mm lead glass having minimum lead capacity of equivalent to 2.2 mm thick to be fixed with 2mm thick mirror finish S.S. frame on both side of door.
- d. **Door Fixtures:-** Suitable Hardware's i.e. D- Type handles, 1mm thick SS 304 Kick Plate and locking arrangement to be provided and doors can be open and closed right hand side or left hand side as per requirement. S.S. guard column to be provided.
- e. **Canopy:-** Canopy over full length of the track of the door to be made up of 1mm thick galvanized sheet cover finished with powder coating. The track top should be sloping and provided with GI sheet end caps etc. complete and fixed with suitable anchors on wall.
- f. The wall opening jamb & ceiling of door to be covered with 1mm thick high pressure laminate fixed with adhesive over 9mm thick high density particle board of and fixed with aluminum frame with suitable screws, anchors.

- g. **Automatic Door Controller:** - Approved make Automatic door controller with motor, 2 hand wave switches for half opening & 2 foot switches for full opening & safety photo shell set to be provided as per requirement.
- h. **Shop drawing:** - The contractor shall submit including required designing shop drawing for doorframes, shutters complete with
 - i. Plan, elevation with relative position of adjacent works
 - ii. Glazing details with type size and fixing
 - iii. Fitting and fixtures with type size, brand and fixing details.
 - iv. Finishing details.
- i. **Sample Approval:-** A sample of Lead lined door including fittings and fixtures, shall be got approved from Engineer – in - charge for final approval before under taking mass production/ fabrication.
- j. **Measurement:** - The measurements shall be done as per BOQ.
- k. **Rates:** - The rates shall be inclusive of all material, T&P, Labour, etc. complete including the cost of fittings, etc. as described above.

24. SIGNAGE & ASSOCIATED WORKS

a. Signage (Internal& External)

- i. The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the Signage, till completion and handing over of the work.
- ii. The item of work for the respective signage shall be conforming to BOQ. However the rate shall cover all operations, fabrications and their installations and materials required for finished product and nothing extra shall be payable on this account.
- iii. The signage work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of such fabricator for the approval of the Engineer-in-Charge.
- iv. The Contractor shall submit the Design, Size and installation procedure along with samples to Engineer-in-Charge for approval. Approved samples will be kept at site till the whole work is completed. Engineer-in-Charge has right to modify the design of the approved samples also during the entire period of the contract without change in rates etc. and contractor is bound to follow these written instruction/ changes in design/ size etc. from Engineer-in-Charge.
- v. The typical patterns shown in the Bill of Quantities are only indicative. The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating signage with detailing of frame work, if any, along with the fixing details. The details of the signage including location, etc. shall be shown in the shop drawings.
- vi. The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the signage work, for approval. After approval of samples of materials, the Contractor shall prepare sample(s) for approval of Engineer-in-Charge. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge. The mock-up

shall be dismantled and removed by the contractor as per the directions of the Engineer-in-Charge. Nothing extra shall be payable on this account.

- vii. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.
- viii. The item includes the cost of all inputs of labour, materials, T & P other incidental charges, wastages etc. The items also included providing and fixing with stainless steel anchor fasteners or other suitable arrangement for fixing the signage.
- ix. The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of Engineer-In-Charge.

b. External Signage

- i. The electrical power supply points, if required, for operation of the signage shall be provided by the CLIENT.
- ii. The contractor shall submit the design for the support structure, including foundations, if required, for the approval of the Engineer in Charge and nothing extra shall be paid to the contractor in this account.

25. HORTICULTURE AND ASSOCIATED WORKS

a. Scope of work

The work shall in general conform to the Latest CPWD Specifications for works. Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the schedule of quantities for Horticulture works.

b. Excavation

The top excavated soil shall be collected, stacked, preserved for use in landscaping / horticulture works. Surplus top excavated soil may be given to the nurseries or put to use in other Horticulture works.

c. GRASSING

1) Preparation

- i. During period prior to planting the ground shall be maintained free from weeds.
- ii. Grading and final leveling of the lawn shall be completed at least three weeks prior to the actual sowing. Clods of excavated earth shall then be broken upto the size not more than 75mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds that re-germinate shall be uprooted carefully. The rubbish arising from this operation shall be removed and disposed of in a manner directed by Engineer. Regular watering shall be continued until sowing by dividing the lawn area into portion or approx 5 mts. Square by constructing small

bunds to retain water. These 'bunds' shall be level just prior to sowing of grass plants. At the time of actual planting of grass, it shall be ensured that the soil has completely settled.

- iii. Slight unevenness, ups and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the final levels by adding suitable quantities of good earth brought from outside, if necessary as directed by the Engineer. In fine dressing, the soil at the surface and for 40mm depth below shall be broken down to particles of size not exceeding 6mm in any direction.
- 2) **SOIL:** The soil itself shall be ensured to satisfaction of Engineer to be a good, fibrous loam, rich in humus.
- 3) **SOWING THE GRASS ROOTS :**
- i. Grass roots (Cynodon dactylon or a local approved by the Engineer) shall be obtained from a grass patch, seen and approved beforehand.
 - ii. The grass roots stock received at site shall be manually cleaned of all weeds and water sprayed over the same after keeping the stock in a place protected from sun and dry winds.
 - iii. Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.
- 4) **EXECUTION:**
- i. Small roots shall be debbled about 15 cms (or at other spacings as per BOQ item) apart into the prepared grounds. Dead grass and weeds shall not be planted.
 - ii. Grass areas will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed.
 - iii. All planting is to be done in moderately dry to moist (not wet) soil and at times when wind does not exceed a velocity of 8 kilometer per hours.

5) MAINTENANCE OF LAWN

- i. As soon as the grass is approximately an inch high it shall be rolled with a light wooder, roller in fine, dry weather and when it has grown to 2 to 3 inches above the ground, weeds must be removed and regular cutting with the scythe and rolling must be begun. A top dressing of announce of guano to the square yard on well decomposed well broken sludge manure will help on the young grass. The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine. It should be possible to use the inch above the normal level of the first two or three cuttings. That is to say the grass should be cut so that it is from 1 to 2 inches in length, instead of the $\frac{1}{2}$ to $\frac{3}{4}$ of an inch necessary for mature grass.
- ii. In absence of rain the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 25 cms.
- iii. Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the contractor.

- iv. Any shrinkage below the specified levels during the contract or defects liability period shall be rectified at the contractor's expense.
 - v. The contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.
- 6) **ROLLING:** A light roller shall be used periodically, taking care that the lawn is not too wet and sodden. Rolling should not be resorted to, to correct the levels in case certain depressions are formed due to watering
- 7) **EDGING:** The contractor shall establish a neat edge where planting areas meet grass areas with spade or edging tool immediately after all planting, including lawn planting, is completed. Particular care shall be exercised in edging to establish good flowing curves as shown on the plans or as directed by the Engineer. Edging must be cut regularly and shall be maintained by the contractor.
- 8) **FERTILIZING:** The lawn shall be fed once a month with liquid manure prepared by dissolving 45 grams of ammonia sulphate in 5 litres of water.
- 9) **WATERING:** Water shall be applied daily during dry weather. Watering whenever done should be thorough and should wet the soil at least upto a depth of 20 cms to eliminate air pockets and settle the soil.
- 10) **WEEDING:** Prior to regular mowing the contractor shall carefully remove rank and unsightly weeds.
- d. **MAINTENANCE:** The landscape contractor shall maintain all planted area within the landscape contract boundaries until the period of one year after the complete plantation. Maintenance shall include replacement of dead plants. Watering, weeding, cultivating, control of insects, fungicide and other disease by means of spraying with an approved insecticide or fungicide, pruning and other horticulture operations necessary for the proper growth of the plants and for keeping the landscape sub-contract area neat in appearance.
- e. **PRUNING & REPAIRS:** Upon completion of planting work on the landscape sub-contract all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the results of transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of the trees. In general, one third to one fourth branching structure of the plants to be removed to compensate the loss of roots during transplantation by thinning or shortening branches but no leaders shall be cut. All pruning shall be done with sharp tools in accordance with instructions of the HLL. Pruning cuts shall be painted with recommended paints.
- f. **TREEGUARDS:** Where tree guards are necessary, care should be taken to ensure that they do not impede movement or restrict growth.
- g. **NURSERY STOCK:** Planting should be carried out as soon possible after reaching site. Where planting must, of necessity, be delayed, care should be taken to protect the plants from pilfering or damage from people or animals. Plants with bare roots should be heeled in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly labeled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

- h. **PROTECTIVE FENCING:** According to local environment shrubs may have to be protected adequately from vandalism until established.
- i. **COMPLETION:** On completion the ground should be formed over and left tidy.
- j. **RATES:** The rates quoted for the horticulture items listed in BOQ shall provide for the cost involved in all the operations described above.

26. SAMPLES OF MATERIALS:

- a. Sample of all materials/ fittings and fixture to be used in the work such as doors, windows, tiles, sanitary, water supply, drainage fittings and fixtures shall be submitted well in advance by the contractor for approval from the Engineer-in-charge of work in writing before placing orders for the entire quantity required for completion of work. Samples approved by the EIC shall be kept in Sample Room under the charge of Engineer-in-Charge and shall retain till completion of work.
- b. Finished items in respect of typical portion of works of repetitive nature such as typical room, toilet, railing, door, window or any other work desired by the Engineer-in-charge shall be prepared by the contractor to the satisfaction of Engineer-in-charge and got approved from him in writing before the commencement of these items for the entire work.
- c. The requirements for preparation of samples shall be observed and fulfilled by the contractor well in advance to avoid any detriment to the general progress of work. In other words, this will not be allowed to have any effects on the general progress of work or on any of the terms and conditions of the contract. No claims of any kind whatsoever including the claims of extension of time will be entertained due to the incorporation of this requirement.

27. GRIHA requirements:

Materials shall be procured by the contractor keeping in view the recycled content to conform the GRIHA requirements as detailed in SCC and elsewhere.

28. VARIATION IN CONSUMPTION OF MATERIALS:

The variation in consumption of material shall be governed as per CPWD specification and clauses of the contract to the extent applicable.

29. MISCELLANEOUS:

Materials manufacture by reputed firms and approved by Engineer – in charge shall only be used. Only articles classified as “First Quality” by the manufactures shall be used unless otherwise specified. Preference shall be given to those articles which bear ISI certification marks. In case articles bearing ISI certification marks are not available the quality of sample brought by the contractor shall be judged by the standards laid down in the latest CPWD specifications. For items not covered by the latest CPWD specification, relevant ISI standards shall apply.

30. TESTS:

- a. Materials brought at site of work shall not be used in the work before getting satisfactory test results for Mandatory tests as per relevant provisions in Latest CPWD Specifications for works. Normally, part rate payment shall be allowed in

the running account bills only if the materials are tested and test results are found to be satisfactory to by the Engineer-in-charge. These tests shall be got done from laboratories approved by Engineer-in - charge or the laboratory set up by the contractor at site as per directions of Engineer-in - charge.

- b. The Engineer-in - charge of work shall check the test results and satisfy himself before allowing any payment in the running /final bill.

CHAPTER C

TECHNICAL SPECIFICATIONS - PLUMBING & SANITARY WORKS

SECTION 1 GENERAL REQUIREMENT

1. Scope of work

The work shall in general conform to the Latest CPWD Specifications for works as mentioned in Schedule 'F' of the General Conditions of Contract. Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the schedule of quantities and / or shown on the plumbing drawings.

SECTION 2 PLUMBING FIXTURES

1. Scope of work

- a. Work under this Part shall consist of furnishing all materials & labour necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories as required by the drawings and specified in the Bill of Quantities.
- b. Without restricting to the generality of the foregoing the sanitary fixtures shall include the following:-
 - i. Sanitary fixtures
 - ii. Bath tubs, shower trays
 - iii. Chromium plated fittings
 - iv. Porcelain or stainless steel sinks
 - v. Accessories e.g. towel rods, toilet paper holders, soap dish etc.
 - vi. Whether specifically mentioned or not, the rates quoted for the installation of the fixtures, appliances and accessories shall be provided with all fixing devices, nuts, bolts, screws, hangers ,fasteners as required.
 - vii. All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

2. General

- a. All sanitary fixtures, CP Fittings and CP/SS accessories shall be supplied at site of work as per manufacturers' standard supply.
- b. All fixtures and fittings shall be provided with all such accessories and fixing devices as are required to complete the item in working condition, even if the same is not specifically mentioned the Bill of Quantities, Specifications or shown on the drawings. The rate quoted will include all devices for proper fixing arrangement, nuts, bolts, screws and required connection pieces etc.
- c. Fixing screws shall be half round head stainless steel wood screws or bolts with Stainless Steel washers. Iron screws rust and will not be permitted.
- d. All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct

positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.

- e. Contractor shall provide poly-sulphide sealant appropriate for its use for all fixtures fixed near wall, marble core seal and edges.

3. Water Closets

a. European W.C.

- i. W.C. shall be any one of the following types:
 - a. Wall hung wash down or
 - b. single or double siphon type or
 - c. As per BOQ
- ii. Each W.C. set shall be provided with an approved type of plastic/wooden seat of approved finish compatible and fitting appropriately with the WC set with rubber buffers and hinges. The WC seat shall be those approved and accepted for fixing on a particular type of WC.
- iii. The seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.
- iv. The edge between the fixture and the wall shall be sealed with approved type of poly-sulphide sealant.

b. Health faucet/spray (Optional)

A chromium plated spray with integral hand control valve and connected to a flexible pipe and angle valve with wall flange and hook are fixed as shown on the drawings or directed by the Engineer-in-charge. The angle valve and flange shall be paid under relevant item with ablation tap.

4. Wash Basins

- a. Wash basins shall wall mounted type or for under over/counter installation as specified in the BOQ.
- b. Each basin shall be supported on **MS galvanized** or painted C.I. brackets and the basin securely fixed to wall or under/above counter installation. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.
- c. Each basin shall be provided with 32 mm dia. C.P. waste with overflow/ pop-up or standard waste with rubber plug and chain, 32 mm dia. C.P. brass bottle trap with CP pipe to wall and flange as specified in the BOQ.
- d. Each basin shall be provided with a single tap a hot & cold CP mixer with or without pop up waste fittings, 32 mm dia. CP cast brass bottle trap with outlet pipe and wall flange.
- e. The edge between the fixture and the wall or the counter shall be sealed with approved type of poly-sulphide sealant
- f. Washbasins 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 Engineer-in-charge.
- g. Each washbasin connection (separately for hot and cold) shall be provided with angle valves with CP wall flange and CP connecting pipe and of required length.

5. Sinks

- a. Sinks used shall be of any of the following types:

- b. For kitchens, pantries, and designated utility rooms the sinks shall be stainless steel sinks with or without drain boards.
- c. Each sink shall be supported by **MS galvanized** or painted C.I. brackets and clips and the basin securely fixed to wall or on the counter. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.
- d. Stainless steel sinks shall be provided with 40 mm dia. C.P. basket waste with plug (as supplied by manufacturer), 40 mm dia. C.P. brass "P" trap with CP pipe to wall and flange.
- e. Each sink shall be provided with hot & cold CP mixer with approved type of a neck spout or individual taps as directed by the Engineer-In-Charge.

6. Shower set

- a. Shower set shall comprise of hot & cold water mixer, C.P. shower arm with wall flange and shower head adjustable type.
- b. Mixer shall be exposed type, single lever, concealed stop cocks with diverter and spout as selected by the Engineer-in-charge.

7. Accessories

- a. Accessories shall be of any of the following types:
 - i. Towel rails
 - ii. Towel rings
 - iii. Coat hooks
 - iv. Soap dispensers
 - v. Soap dishes
- b. Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good.
- c. 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. The flange of the recessed fixture shall cover the recess in the wall fully.

8. Cutting of holes and making chases etc.

Rates shall be inclusive of cutting holes and chases and making good the same, stainless steel screws, nuts, bolts, fastener and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

SECTION 3 Soils, Waste, Vent& Rainwater Pipes & Fittings

1. Scope of work

- a. Work under this Part shall consist of furnishing all labour, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings, and given in the Schedule of Quantities.
- b. Without restricting to the generality of the foregoing, the system shall include the following:-
 - i. Vertical and horizontal soil, waste, vent and rain water pipes, and fittings, joints, clamps and connections to fixtures.

- ii. C.I. soil & uPVC rainwater pipes.
- iii. Connection of all pipes to sewer lines as shown on the drawings at ground floor levels.
- iv. Floor and urinal traps, cleanout plugs, inlet fittings and rainwater headsic/Khurras.
- v. Testing of all pipe lines.

2. General requirements

- a. All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-charge.
- b. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- c. 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.
- d. Pipes shall be securely fixed to walls and ceilings by suitable clamps intervals specified.
- e. Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

3. Piping System

- a. Soil, Waste & Vent Pipes
 - i. The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in BIS: having separate pipes for waste for kitchen sinks, showers, washbasins, AHU's condensate drains and floor drains and is approved by Engineer-in-charge.
 - ii. All waste water from AHU's plant and pump rooms, floor channels in basements will be provided with a deep seal trap before connecting to the main drain or vertical stack.
 - iii. Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement ceiling or to an external manhole directly where feasible and shown on the drawings.
- b. Rainwater Pipes
 - i. All terraces shall be drained by providing down-takes rainwater pipes.
 - ii. Rainwater pipes are separate and independent and connected to the storm water drainage system as shown on the drawings.
 - iii. Rainwater in enclosed courtyards shall be collected in catch-basins and connected to storm water harvesting chambers as shown in drawings..
 - iv. Any dry weather flow from waste appliances, AHU's pump rooms, shall not be connected to the sewerage system.
- c. Balcony/Planter drainage

All balconies, terraces, planters and other formal landscape areas will be drained by vertical down takes as per the landscape/architectural drawings and details.
- d. Cast iron pipes & fittings (for Soil, waste, anti-siphon age pipes)

- i. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. Pipes shall be centrifugally spun iron soil pipes conforming to sand cast to I.S. 3989.
- ii. Standard weight dimensions shall be as follows:-
 - a. Sand Cast Iron Pipes & Matching Fitting shall be in conformity to I.S. 1729
 - b. Centrifugally cast (spun) iron pipes and fittings in conformity to I.S. 3989
- e. uPVC pipes & fittings (For Rain Water Pipes etc.)
 - i. Where specified, Polythene pipes shall be uPVC pipes confirming to I.S: 4985-1988. The details of the nominal outer diameter, weight and working pressure shall be as per the standards, for the respective pressure rating as specified in the B.O.Q.
 - ii. Polythene pipes may be cold bending to a radius of not less than eight times of their external diameter. Pipes bent for smaller radius may be made by hot bending.
 - iii. Fittings used for Polythene pipes shall be compression moulded fittings matching to the above specifications.
- f. Jointing
 - i. All Polythene pipes shall be Drip seal/Sealant and jointed as per manufacturer's specifications and relevant I.S codes.
 - ii. All pipes shall be tested after installation for a pressure equal to twice the maximum working pressure in the line as per manufacturer's specifications.
- g. Fittings
 1. Fittings shall conform to the same Indian Standard as for pipes. Pipes and fittings must be of matching IS Specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.
 2. Fittings shall be of the required degree of curvature with or without access door.
 3. Access door shall be made up with 3 mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal later. The fixing shall be air and water tight.
- h. Fixing
 1. All vertical pipes shall be fixed by structural support clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).
 2. Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps (Clevis clamps) of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.
 3. Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the

Engineer-In-Charge/Building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

4. Traps

a. Floor traps

Floor traps shall be siphon type full bore P or S type cast iron having a minimum 50 mm deep seal. 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 centring for the blocks. Size of the block shall be 30x30 cm of the required depth.

b. Urinal traps

Urinal traps/horn shall be cast iron P or S traps with or without vent and set in cement concrete block specified for floor traps.

c. 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 inlet fitting fabricated from G.I. pipe without, with one, two or three inlet sockets welded on side to connect the waste pipe. Joint between waste and hopper inlet socket shall be Drip Seal. Inlet shall be connected to a C.I. P or S trap. Floor trap inlet hoppers and the traps shall be set in cement concrete blocks as specified in para above without extra charge.

d. Gratings for traps

Floor and urinal traps shall be provided with 100-150mm square or round C.P. / Stainless steel grating / PTMT, with rim of approved design and shape as per BOQ.

e. Jointing

Soil, waste, vent and anti-siphonage pipes shall be jointed with Lead joint/Drip seal joint as mentioned in the BOQ. The following minimum procedures shall be complied with while making the pipe joints:-

- i. Ensure that the pipes are clean internally and undamaged.
- ii. The pipes shall be cut square with sharp tools.
- iii. The cut ends of the pipes shall be filed/ reamed and finished smooth.
- iv. Any deformed ends shall be re-rounded.
- v. It shall be ensured that the pipe ends shall enter the fittings and sockets to full depth of the jointing area.
- vi. The pipe work shall be assembled in a manner such that it does not entail making of joints in restricted locations.
- vii. Each metal pipe spigot shall be centered with three lightly wedged pieces of hardwood or folded lead.
- viii. The jointing surfaces shall be cleaned to remove any coatings or cutting oils, etc.

f. Floor Trap Inlet/GI Inlet Fitting:

Traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type cast iron or G.I. inlet hopper without or with one or two or three inlet sockets to receive the waste pipe. Joint between G.I. waste pipe and hopper inlet socket shall be Drip seal joint. Hopper shall be connected to a CI 'P' or 'S' trap with at least 50mm seal (hopper and traps shall be paid for separately). Floor trap inlet hoppers and the traps shall be set in cement concrete blocks/and supports as required for Floor trap above shall be provided without any extra charge.

5. Cleanout Plugs

a. Cleanout Plug on soil pipes

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

b. Cleanout Plug on Drainage Pipes

- i. Cleanout plugs shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Engineer-in-charge. Cleanout plugs shall be of size matching the full bore of the pipe but not exceeding 150 mm dia. Cleanout Plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.
- ii. Cleanout Plug at Ceiling Pipes: - Cleanouts provided at ceiling level pipe shall be fixed to a CI flanged tail piece. The cleanout doors shall be specially fabricated from light weight galvanised sheets and angles with hinged type doors with fly nuts, gasket etc., as per drawing.

6. Waste pipe from appliances

a. General

- i. Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of heavy galvanized steel /CPVC as given in the Schedule of Quantities or shown on the drawings.
- ii. 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 galvanized structural clamps. Spacing for clamps for such pipes shall be as per good engineering practice approved by the Engineer-In-Charge.

b. Galvanized pipes

Waste pipes from appliances shall be galvanized steel tubes conforming to I.S.1239 (Heavy class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. tees, couplings, bends, elbows, unions, reducers, nipples, plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter. Pipes in chase shall be wrapped with bitumen tape and then painted with two coats of black bitumen paint. Exposed pipes with one coat of Zinc chromate with etch coating primer and two or more coats of synthetic enamel paint or as given in the Schedule of Quantities. Colour shall be as per the approved colour code.

7. Cast iron pipes for drainage

- a. All drainage lines passing under building, in exposed position above ground e.g. basement ceiling etc. shall be cast iron pipes. Position of such pipes shall generally be shown on the drawings.
- b. Cast iron pipes shall be spigot & socket (S&S) centrifugally spun iron pipes conforming to I.S. 1536. (Class LA). Quality certificates shall be furnished.
- c. Fittings
Fittings used for C.I. drainage pipe shall conform to I.S. 1538 (Heavy class). Wherever possible, junction from branch pipes shall be made by a Y- tee.
- d. Joints
 - i. Joints between pipes shall be made with pre-moulded rubber joints (Tyton Joints) supplied by the manufacturer to ensure compatibility and water tightness.
 - ii. Joints between pipes and fittings shall be made by caulked spun yarn dipped in tar and molten drip seal 45 mm deep by hammering with caulking tools.

8. Encasing pipe in Cement Concrete

Cast iron soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8 m. Rate for concrete round pipes shall be inclusive of pillars, supports, shuttering and centring.

9. Painting

- a. All cast iron, soil, waste vent, anti-siphon age and rainwater pipes in exposed location in shafts and pipe spaces shall be painted with two or more coats of synthetic enamel paint to over a priming coat to give an even shade.
- b. Paint shall be of approved quality and shade. Where directed pipes shall be painted in accordance with approved pipe colour code.
- c. G.I. waste pipes in chase shall be painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint over each priming coat.
- d. C.I. soil and waste pipes below ground and covered in cement concrete or lead pipes shall not be painted.

10. Cutting and making good

- a. Pipes shall be fixed and tested as building proceeds.
- b. Contractor shall provide all necessary holes cut outs 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 brick work in cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

11. Testing

- a. Testing procedure specified below apply to all soil, waste and vent pipes above ground including C.I. LA pipes laid in basement ceiling.
- b. Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing shall be certified for its calibration by an approved laboratory.
- c. All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site. All testing equipment must be calibrated and shall carry certificate from an approved laboratory.
- d. Testing soil, waste and rainwater pipes
 - i. Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.
 - ii. After installation all connections from fixtures, vertical stacks and horizontal drains including C.I. LA pipes shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.
 - iii. The entire installation shall be tested by smoke testing machine. The test can be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging all inlets by bellow plugs. Apply dense smoke keeping the top of stack open and observe for leakages. Rectify or replace defective sections.
 - iv. After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self-draining, has no leakages, blockages etc. Rectify and replace where required.
- e. Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of Engineer-in-charge and signed by both.

12. Measurements

- a. General
 - i. Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities.
 - ii. Rates are applicable for the work under floors, in shafts at ceiling level area for all heights and depths.
 - iii. Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.
 - iv. Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.

- v. Pipes (Unit of measurement, linear meter to the nearest Centimetre) or as specified in CPWD specifications.
- b. All C.I. Soil, waste, vent, anti-syphonage and rain water pipes shall be measured net when fixed correct to a centimetre including all fittings along its length. No allowance shall be made for the portions of pipe lengths entering the sockets of the adjacent pipes or fittings. The above will apply to both case i.e. whether pipes are fixed on wall face or pillars or embedded in masonry or pipes running at ceiling level.
- c. Pipes shall be measured per running metre correct to a centimetre for the finished work which shall include fittings e.g. bends, tees, elbows, reducers, crosses, sockets, nipples and nuts. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal diameter of internal bore. The pipes shall be described as including all cutting and waste. In case of fittings of unequal bore, the largest bore shall be measured.
- d. Cement concrete around pipes shall be measured along the centre of the pipe line measured per linear metre and include any masonry supports, shuttering and centring cutting complete as described in the relevant specifications.
- e. Slotted angles/channels shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.
- f. Fittings
Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.
- g. Painting
Painting of pipes shall be measured per running metre and shall be inclusive of all fittings and clamps. No deduction for fittings shall be made.
- h. Excavation for soil pipes
No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for cast iron soil and waste pipes laid below ground, in sunken slabs.
- i. Engineer-in-charge's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION 4 Water Supply Systems

1. Scope of work

- a. 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 Schedule of Quantities.
- b. Without restricting to the generality of the foregoing, the water supply system shall include the following:-

- i. Rising main from water supply pumps to all overhead tanks.
- ii. Distribution system from overhead tank to all fixtures and appliances for cold & hot water.
- iii. Insulation to hot water pipes within toilets.
- iv. Connections to all plumbing fixtures, and appliances.

2. General requirements

- a. 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.
- b. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- c. 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.
- d. As far as possible all bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 25 mm dia. Bends and elbows may be used for pipe dia. greater than 32 mm.
- e. 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.
- f. Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals approved by the Engineer-In-Charge.
- g. Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3. Water Supply System

- a. Contractor should study the site plan and water supply system diagram for overviews of the system.
- b. Source
 - i. Water supply will be acquired from HLL's mains line (water report enclosed).
 - ii. The rising mains will be connected to the main fire static tank and then overflow into the main domestic water tank located in basement.
- c. Water supply piping for garden hydrant and sprinkler and irrigation system will be separate and independent connected to a different pumping system.

4. G.I/ CPVC Pipes & Fittings

- a. All pipe inside the building and where specified, outside the building shall be galvanized / CPCV steel tubes conforming to I.S. 1239 of class specified. When class is not specified they shall be heavy class.
- b. Fittings shall be malleable iron galvanized /CPCV of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I. /CPCV pipe shall include couplings, bends tees, reducers, nipples, union and bushes. Fittings shall conform to I.S. 1879-(Section I to X).
- c. Pipe and fittings shall be joined with screwed joints, after cutting a pipe with a hacksaw or a cutting machine care shall be taken to remove burr from the end of the pipe after reaming with a proper file.

- d. Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply.(Use of red and white lead sutli will not be permitted for screwed joints)
- e. 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./CPCV pipes inside shall be fixed in wall chases well above the floor. No floor shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings.

f. Clamps

- i. G.I/CPCV pipes in the shaft and other locations shall be supported by clamps of design approved by Engineer-In-Charge. Pipes in wall chases shall be anchored by hooks. Pipes at ceiling level shall be supported on structural clamps.
- ii. Spacing of clamps, hooks etc. Shall be as per good engineering practice approved by the Engineer-in-charge

g. Unions

Contractor shall provide adequate number of unions on pipes 50mm and below to enable easy dismantling later when required .Unions shall be provided near each gunmetal valve , stop clock , or check valve and go on straight runs as necessary at appropriate locations as required and /or direct by Engineer-In-Charge.

h. Flanges

- i. Flanged connections shall be provided on pipes 65 mm and above as required or where shown on the drawings generally as follows:
 - 1. On straight runs not exceeding 30 m, near bends and at connections to main branch lines.
 - 2. On all valves ends
 - 3. On equipment /pump connections as necessary and required or as directed by Engineer – in - charge.
- j. Flanged connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion neoprene gaskets Bolt hole dia. for flanges shall conform to match the specification for C.I. sluice valve to I.S. 780 and C.I. butterfly valve to IS: 13095.

k. Trenches

- i. All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:-

Dia. of pipe	Width of trench	Depth of trench
15 mm to 50 mm	30 cm	75 cm
65 mm to 100 mm	45 cm	100 cm

- ii. **Sand filling:-** Where specified in the Schedule of Quantities all G.I. pipes in trenches shall be protected with fine sand 15 cm all around before filling in the trenches.

- l.** Where shown on the drawings, main pipe lines may be run in masonry trenches from the pump house to the buildings in phase I & II , filled up with sand and buried in ground as per architectural /landscape details.

m. Painting

All pipes above ground shall be painted with one coat Zinc with each coating and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code specified by Engineer-in-charge.

n. Pipe protection

- i.** Where specified in the Schedule of Quantities all pipes in chase or below floor shall be protected against corrosion by the application of two coats of bitumen paint covered with bitumen tape and a final coat of bitumen paint before covering up the pipe.
- ii.** All G.I. / CPVC water supply pipes below ground shall be protected against corrosion by applying one layer of 4 mm thick multilayer anticorrosive polymeric mix tape applied over a coat of primer as per recommendations of the manufacturers. (Pypcoat)

o. Insulation

Hot water pipes within a toilet /kitchen from hot water header shall be insulated with fire resistance closed cell chemically cross linked polyethene is used in the forms of rolls, sheets and tubes. The thickness of insulation is 13mm on all sizes of pipes. Density of insulation is $30 \pm 2 \text{ kg/cum}$.

5. Valves

a. Ball valves

- i.** Valves 50 mm dia. and below shall be screwed type ball valves with stainless steel balls spindle Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm^2 and accompanying couplings and steel handles to B.S. 5351.

b. Butterfly Valves

- i.** Valves 65 mm dia. and above shall be cast iron butterfly valve to be used for isolation and/or flow regulation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction. Valves shall be provided with matching flanges with neoprene insertion gasket 3 mm thick .P.N 1.6
- ii.** Butterfly valve shall be of best quality conforming to IS: 13095.

c. Non Return Valve

- i.** Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only, It shall be single door swing check type of best quality conforming to IS: 5312.P.N1.6
- ii.** Each butterfly and slim type swing check valves shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanized nuts, bolts and double washers of correct length.
- iii.** Sluice valve shall be of approved makes conforming to I.S.:780 of class as specified.

6. Storage Tanks

a. Overhead Tanks

Overhead water storage tanks for water supply shall be reinforced cement concrete.

b. Tank connection and accessories

- i. Contractor shall provide the following to each tanks:
 1. Inlet and outlet connections to pumps, equipment and main pipe lines.
 2. Tank overflows with mosquito proof gratings
 3. Scour drain and valve as per drawings
 4. Water level gauge with approved type of brass gauges, plastic tube, a wooden board with level marking.
- ii. Electronic level controllers, cabling, sequence controllers and all related equipment shall be provided by agency executing the pumping system work. Plumbing contractor shall provide necessary G.I. sleeves and co-operate with the contractor to ensure that the work is successfully executed.

7. Testing

- a. All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg /cm² whichever is more. Pressure shall be maintained for a period of at least 12 hours without any drop & withstand for 8 hrs.
- b. A test register shall be maintained and all entries shall be counter-signed by Contractor(s) in the presence of Engineer-in-charge.
- c. 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 by the Contractor during the defects liability period without any cost.
- d. After commissioning 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.

8. Measurements

- a. G.I./CPVC pipes
 - i. G.I./CPVC pipes above ground shall be measured per linear metre (to the nearest cm) and shall be inclusive of all fittings e.g. couplings, tees, bends, elbows, unions, and flanges. Deduction for valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chases and making good the same and all items mentioned in the specifications and Schedule of Quantities.
 - ii. G.I./CPVC pipes below ground shall be measured per linear metre (to the nearest cm) and shall be inclusive of fittings, e.g. couplings, tees, bends, elbows, unions. Deduction for valves shall be made. Rates quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus

earth, cutting holes and chases and making good and all other items mentioned in the specifications and Schedule of Quantities.

- b. Gunmetal, cast iron, butterfly and non-return valves puddle flanges, level indicators and meters shall be measured by numbers.
- c. Brick masonry chamber for valves and meters shall be measured by number and include all items given in the Bill of quantities.

- d. Painting/pipe protection

Painting/pipe protection for pipes shall be measured per linear metre over finished surface and shall include all valves and fittings for which no deduction shall be made.

- e. Engineer-In-Charge's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION – 5 Water Supply Pumping System & Allied services

1. Scope of work

- a. Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required for the satisfactory supply, installation, completion and commissioning of water supply pumping system and allied works as described hereinafter, as specified in the schedule of quantities and/or shown on the plumbing drawings and described in the scope of work .

2. The System

- a. The system described below is for the contractors bidding for the works to understand the extent and scope of work and the intent in the manner in which the water supply system is planned and shall be executed. This does not form a part of the contractor's scope of work with respect to the various elements that are described in this paragraph.

b. Sources of supply

Local water supply for which a water main from the main road to the underground water tank will be laid by contractor.

c. Underground water tanks

- i. Static fire water storage tanks in compartments. Connections from the tube well water supply lines will be made into these tanks. Water will overflow into the raw water tanks
- ii. Raw Water Tank to hold the tube well as well as CWS Supply water will be made to:
 - 1. A set of pumps will be connected to and water filter and chlorination system and the filtered water stored in the Treated Water Tanks (in three compartments. All piping and connections for this system are a part of this contract, if required.
 - 2. Domestic Water Pumping Systems
- iii. Water supply to the various buildings will be made from a set of pumping sets to the overhead water and supplementary fire tanks located on the terrace of each building.

3. Rising Mains & level control system

- a. Water from the pumps described above will fill each tank by a rising main to each tower.
- b. To control the level in each tank and enable it to fill as the water demand so requires, each tank will be provided with a ball cock to shut off the water supply when the tank is full.
- c. A set of electronic level sensing probes will be installed in each tank. The probes installed in each pumping system will be wired to a central electronic panel which will activate the pump when any one of the tank probe signals low water conditions and top up all tanks. No excess flow will occur due to the ball cock in the tank.

4. Level Controllers

- a. Level controllers shall be electronic magnetic type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe. The level controller will be used for following applications:-
 - i. Provide a audible high water alarm when water level in the sump reaches a pre-determined high level in the sump location at MCC panel installed in wall near sump location
- b. Overhead tank level controller cum indicators
 - i. Each OHT to be provided with required number of stainless steel electronically operated probes (housed in a stainless steel protective housing) and connected by a control cable to a central junction box connected to MCC panel located in the pump house at basement. A common multi-core cable from each group of buildings will be laid to the pump room in basement. The probes will function as follows:
 - ii. To cut off the water supply pumps when all the OHT is full and to start the pump if any OHT level reaches at pre-determined low level.
 - iii. Provision shall be made to enable the operation of the second duty pump in case the water level does not rise above a pre-determined level in the tank due to water demand which is higher than capacity of duty pump no.1 to meet.
 - iv. Indicate the water level in each OHT in the level indicating panel installed in the pump room
 - v. Each OHT are also provided with a float valve to stop the supply in individual OHT when level reaches a cut off high level.
- c. Control & Indicating Panel (For overhead and underground water tanks)
 - i. A centralized indicating stand-alone wall mounted panel fabricated from 14 g. with seven tank process MS sheet and painted inside and outside with stove enamelled finish with clear vertical panels for each group of buildings & tanks shall indicate water level in each tank by means of digital display unit to indicate water level in each tank in four levels ($\frac{1}{4}$ th, $\frac{1}{2}$, $\frac{3}{4}$ and full). The panel shall be installed on the control console panel located in the pump room or as directed by the Project Engineer. The panel shall have:
 - ii. Digital level indicator panel meter for each water tank.
 - iii. Etched plate identification plates.

- iv. Control cabling from MCC to the panel installed in the control room as directed by the Engineer-In-Charge.
- v. Cabling from PHT sensing probes to the panel

5. Pressure filters for Water Supply System, if required.

- a. Specification shall apply for water filtration system
 - i. Pressure filters shall be manufactured with factory made bobbin wound polyester fibre glass multilayer filters fitted with internal GI distribution pipe with polypropylene diffusers on top, collector pipes and arms, inlet and outlet header vertical water pressure dished ends complete with initial charge of filter media, G.I. face piping, accessories testing and commissioning complete, Working Pressure 2.4 kg/cm² (Test pressure 3.75 kg/cm²). Along with bfv & nrv & gauge, prv etc.
 - ii. Each vessel will be provided with suitable pressure tight manhole cover appropriately located for inspection and repairs.
 - iii. The diameter and height of each vessel shall be as per the design requirement and given in the BOQ and as per site conditions.
- b. Multi-Port Valves
 - i. Each vessel will be provided with multi-port valves to operate and regulate the normal flow, backwash and rinsing, rapid washing, on the face piping.
 - ii. Provide suitable sampling cocks to draw water samples for raw water and treated water.
- c. Face Piping
 - i. Each vessel shall be provided with non-corrosive face piping from the inlet to the outlet. Face piping shall be CPVC (IS 4985) 10 kg/cm² all CPVC fittings are heavy grade to pipe and solvent weld and flanged joints
 - ii. All valves shall be butterfly valves as specified in the piping section over 65 mm dia. and for pipe dia. below 50 mm dia. shall be provided with ball valves.
- d. Water Filtration Plant (For Domestic Water)**
 - i. Design parameters for the proposed filter shall be as follows:
 - 1. Filter media: - Graded aggregate of required size selected coarse and fine silica sand as per latest water treatment practice. Aggregate and sand to be acid washed and having purity of 99.9%.
 - 2. Depth of filter media:- Approx. 750-900 mm deep (as per manufacturer's design)
 - 3. Back washing :- By air scouring through air blower (approx. 5.1 lpm/m² of filter surface area and water supply from raw water pumps by reverse flow)
 - 4. Output Water Quality for Domestic Filters: To conform to IS 10500 for the relevant design criteria
- e. Chemical Dosing Pumps**
 - i. Pump applications

1. Chlorination of raw water from tube wells,
 - ii. Dosing system comprising of an electronic metering pump with, 100 lit capacity uPVC/HDPE solution tank with level gauge and lid on top.
 - iii. Electronic driven metering pumps with mechanically actuated diaphragm with oil lubricated gear mechanism. The output of the pump should be adjustable for operation from 10-100%. Pump construction shall be corrosion resistant polypropylene or similar material. Pump electrical circuit shall be interlocked with the main raw water /pool recirculation pumps so that they operate only when the pumps are operating.
- f. Air Blower for Back Washing**
- i. Low pressure air blower with TEFC electrical motor, belt driven or direct drive, all mounted on a common structural based plate with oil and water separator.
 - ii. Air blowers will be used for back washing operations. The air blower shall be designed for operation of one filter at a time. Blowers will be designed for air flow of approx 5.1 lpm/m² air capacity at 0.5 kg/cm² pressure. (This may be modified to suit manufacturer's requirement for filters offered.)
 - iii. The electrical switchgear shall be included in the respective MCC panel of the system

SECTION 6 Pipes & Fittings

1. Headers, piping and connections

- a. All pipes within the plant room building in exposed locations and shafts including connections buried under floor and for suction and delivery headers shall be G.I. / CPVC pipes (medium class) and thickness specified. Pipes up to 150 mm dia. shall conform to I.S. 1239.
- b. Pipe 200 mm dia. and above shall be G.I. ERW tubes to IS 3589. If black pipes are available they shall be galvanized before use.
- c. Fittings for G.I. pipes shall be approved type malleable iron or wrought iron screwed galvanized fittings for screwed joints. Fittings 200 mm dia. may be shop fabricated but shall be shop galvanized after fabrication.
- d. All M.S. structural supports and clamps shall be galvanised. All the pipe work within plant room shall be adequately supported with G.I. structural supports from floor or ceiling as required and directed by Engineer-In-Charge.

2. Jointing

a. G.I. Pipes (Screwed joints)

Pipe shall be provided with metal to metal threaded joints. Teflon tape shall be used for lubrication and rust prevention. (USE OF LEAD /ZINC BASED JOINTING COMPOUND ARE NOT PERMITTED)

b. Flanged joints / Dead Joints

- a. Flanges shall be provided on:
 - i. Straight runs not exceeding 12-15 m on pipe lines 80 mm dia and above.

- ii. Both ends of any fabricated fittings e.g. bends, tees etc. of 50 mm dia or larger diameter. (When Permitted)
- iii. Both end of all suction delivery and other headers.
- iv. For jointing valves, appurtenances, pumps, connections with pipes, to water tanks and other places necessary and required as good for engineering practice.
- v. Flanges shall be as per applicable I.S. with appropriate number of G.I. nuts and bolts, 3 mm insertion rubber gasket complete.
- vi. The cost of flanges is included in the rates of pipes along with fittings.

c. Unions

Provide approved type of dismountable unions on pipes lines 50 mm and below near valves or inspector test/drain and assemblies and as required as per site conditions.

d. Vibration Eliminators

All suction and delivery lines and as shown on the drawings double flanged reinforced neoprene bellow type flexible pipe connectors shall be provided. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer's details.

3. Valves

a. Sluice valves

- i. Full way Sluice Valves shall be used on the suction connection to pumps and headers.
- ii. Sluice valves (80 mm dia. and above) shall be C.I. double flanged sluice valves with rising stem. Each sluice valve shall be provided with wheel in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for sluice valves with cap tops.
- iii. Sluice valves shall be of approved makes conforming to I.S.780 PN1.6 class

b. Butterfly Valves (PN 1.6 rating)

- i. Butterfly Valves shall be used in all other locations as required conforming to IS 13095.PN 1.6
- ii. They shall have a cast iron body.
- iii. Disc shall be CI heavy duty electrolyses nickel plated abrasion resistant.
- iv. The shaft to be EN-8 Carbon Steel with low friction nylon bearings.
- v. The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.
- vi. Built in flanged rubber seals.
- vii. Actuator to level operated for valves above ground and T Key operated for valves below Ground.
- viii. Built in flanges for screwed on flanged connections. Manufacturer's details on fixing and Installation will be followed.

c. Non Return Valves (NRV PN 1.6 rating))

- i. Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.
 - ii. NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges. Valves shall conform relevant IS or match the butterfly valves.PN 1.6
 - iii. Built in flanges for screwed on flanged connections.
- d. Ball Valves
- Ball Valves up to 40 mm dia. shall be screwed type ball valves with stainless steel balls, spindle, Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm² and accompanying coupling and steel handles (to B.S. 5351.

4. 'Y' Strainers (PN 1.6 rating)

Provide cast iron 'Y' type strainers with gunmetal internal strainers, CI screwed plug to be provided on all water tank suction connections to pumps.

5. Measurements (Part 1, 2 & 3)

a. General

- i. Unit rate for individual items, e.g., pressure tanks, MCC, level controller, water tank are for purposes of payments only. Piping, headers, valves, accessories, cabling and MCC to measured separately in this contract only.
- ii. All items must include all accessories fittings as described in the specifications, BOQ and shown on the drawings.

b. Drainage Pumps & Sewage Pumps

Drainage pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

c. Level controllers & Alarms

Level controllers for each set of pumps shall be measured by number and inclusive of probes, cabling up to surface box near the pump and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

d. Piping Work

- i. Suction and delivery headers for each pumping system shall be measured per set with required length and shall include all items as given in the schedule of quantities. Painting shall be included in rate of headers.
- ii. CPVC pipes between various filters and units shall be measured per linear meter of the finished length and shall include all fittings, flanges, jointing, clamps for fixing to walls or hangers and testing. Flanges shall include 3 mm thick insertion rubber gasket, nuts, bolts and testing.
- iii. Vibration eliminators, "Y" strainers, butterfly valves, slim non return valves, ball valves shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications except from pump room.

SECTION 7 Specifications for Electrical Installation

1. Electrical Control Panels

a. General

- i. All medium voltage switchboards shall be suitable for operation at three phase/three phase, 4 wire, 415 volt, 50 Hz, neutral grounded at transformer system with a short circuit level withstand of 31 MVA at 415 volts or as per schedule of quantities.
- ii. The Switch Boards shall comply with the latest edition with up to date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

b. Switch Board Configuration

- i. The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipment as called for in the Schedule of Quantities.
- ii. The MCCB's shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.
- iii. The Switch Boards shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear.

c. Equipment Specifications

- i. All equipment used to configure the Switch Board shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and to the detailed technical Specifications as included in this tender document.

d. Constructional Features

- i. The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.
- ii. The Switch Boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 54 as specified. All doors and covers shall also be fully gasket with synthetic rubber and shall be lockable.
- iii. The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.
- iv. All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.
- v. Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self-threading screws shall not be used in the construction of the Switch Boards.

e. Switchboard Dimensional Limitations

- i. A base channel 100 mm x 50 mm x 6 mm thick shall be provided at the bottom.
- ii. A minimum of 200 mm blank space between the floor of switch board and bottom most units shall be provided.
- iii. The overall height of the Switch Board shall be limited to 2300 mm.

- iv. The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

f. Switch Board Compartmentalisation

- i. The Switch Board shall be divided into distinct separate compartments comprising.
- ii. A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical bus bars.
- iii. Each circuit breaker and MCCB shall be housed in separate compartments enclosed on all sides.
- iv. Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "on" and "off" position.
- v. For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, bus bars and connections.
- vi. A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
- vii. Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.
- viii. Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from top.
- ix. Adequate and proper support shall be provided in cable compartments to support cables.

g. Switch Board Bus Bars

- i. The Bus Bar and interconnections shall be of electrolytic Copper/ Aluminium and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. The maximum current density for copper shall be 1.2 Amps per sq. mm. and for Aluminium shall be 0.8 Amp per Sq. mm. and suitable to withstand the stresses of a 31 MVA fault level at 415 volts for 1 second or as per schedule of quantities.
- ii. The bus bars and interconnections shall be insulated with insulation tape/ fibre glass.
- iii. The bus bars shall have uniform cross-sectional area across its entire length and will be extensible on either side of the Switch Board.
- iv. The bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.
- v. All bus bars shall be colour coded.
- vi. All bus bar connections in Switch Boards shall be bolted with brass bolts and nuts. Additional cross section of bus bars shall be provided wherever holes are drilled in the bus bars.

h. Switch Board Interconnections

- i. All connections between the bus bars/Breakers/cable terminations shall be through solid tinned copper strips of adequate size to carry full rated current and PVC/fibre glass insulated.
- ii. For unit ratings up to 100 amps PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of all such interconnections shall be crimped and aluminium lugs shall be used.

i. Draw out Features

- i. Air Circuit Breakers shall be provided in fully draw out cubicles. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. The fixed and moving contacts shall be easily accessible for operation and maintenance. Mechanical interlocks shall be provided on the draw out cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

j. Instrument Accommodation

- i. Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switch Board.
- ii. For MCCB's instruments and indicating lamps can be provided on the compartment doors.
- iii. The current transformers for metering and for protection shall be mounted on the solid copper/aluminium bus bars with proper supports.

k. Wiring

All wiring for relays and meters shall be with PVC insulated Fire Resistant (FR) copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm.

l. Cable Terminations

- i. Knockout holes of appropriate size and number shall be provided in the Switch Board in conformity with the location of incoming and outgoing conduits/cables.
- ii. The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear / top of the panel.
- iii. The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.
- iv. The Switch Boards shall be complete with tinned brass cable sockets, tinned brass compression glands, gland plates, supporting clamps and brackets etc for termination of 1100 volt grade aluminium conductor PVC/PVCA cables.

m. Earthing

A main earth bar of G.I./Copper/ Aluminium as required shall be provided throughout the full length of the Switch Board with a provision to make connections to the can be tap from main earthing.

n. Sheet Steel Treatment and Painting

- i. Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- ii. All sheet steel shall after metal treatment be powder coated with Siemens Gray shade RAL 7032 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 60 microns.

o. Name Plates And Labels

Suitable engraved white on black metallic name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

2. Testing

Copies of type test carried out at ACB / MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Engineer-In-Charge reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the routine tests as per relevant clause of SCC

3. Testing at Site

- a. Pre-commissioning tests as required and as per manufacturers recommendations shall be carried out on each switchboard at site before energizing the switchboards including but not restricted to the following.
 - i. Physical checking of the switchboards including checking alignment of panels, interconnection of Bus bars, tightness of bolts/connections and evidence of damage/cracks in any components.
 - ii. Physical checking and inspections of Inter panel wiring
 - iii. Checking free movement of ACBs/MCCBs/SFUs
 - iv. Checking of operation of breakers
 - v. Insulation tests of bus bar supports and control wiring etc. with 1.1 kV megger.
 - vi. Primary & secondary injection tests of relays and CTs.
 - vii. Checking of Interlocking function.

4. Cables

i. Medium Voltage Cables

- a. Medium voltage cables shall be aluminium conductor PVC insulated, XLPE sheathed armoured conforming to IS 7098. Cables shall be rated for 1100 Volts. The conductor of cables from 16 mm² to 50 mm² shall be stranded. Sector shaped stranded conductors shall be used for cables of 50

mm² and above. Conductors shall be made of electrical purity aluminium 3/4 H or H temper. Conductors shall be insulated with high quality PVC base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanised compound. Armouring shall be applied over 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 Cores	:	Red and Black
3 Cores	:	Red, Yellow and Blue
3.5/4 Cores	:	Red, Yellow, Blue and Black

b. Current ratings shall be based on the following conditions.

- i. Maximum conductor temperature 70° C
- ii. Ambient air temperature 45° C
- iii. Ground temperature 30° C
- iv. Depth of laying below ground level 750 mm

c. Short circuit rating of cables shall be as specified in IS 7098 Part-I.

d. Cables have been selected considering conditions of maximum connected loads, ambient temperature, grouping of cables and allowable voltage drop. However, the contractor shall recheck the sizes before cables are fixed and connected to service.

e. M.V. cables shall be PVC insulated aluminium/copper conductor and armoured XLPE cables conforming to IS Codes. Cables shall be armoured and suitable for laying in trenches, duct and on cable trays as required. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and un armoured cables.

ii. **On Trays/Walls**

a. Wherever so specified, cables shall be laid along walls/ceiling or on cable trays. Cable shall be secured in position and dressed properly by means of suitable clamps, hooks, saddles etc. such that the minimum clear spacing between cables is diameter of the cable. Clamping of cables shall be at minimum intervals as below.

Type of Cable	Size	Clamping by	Fixing Interval
MV	Up to and including 25 sq mm	Saddles 1 mm thick	45 cms
MV & HV	35 sq mm to 120 sq mm	Clamps 3 mm thick 25 mm wide	60 cms
MV & HV	150 sq mm and above	Clamps 3 mm thick 40 mm wide	60 cms

Note: The fixing intervals specified apply to straight runs. In the case of bends, additional clamping shall be provided at 30 cm from the centre of the bend on both sides.

b. Cable trays

- i. Channel or of ladder design as specified in BOQ. Cable trays shall be fabricated from sheet G.I of thickness as per BOQ Cable trays, of sizes as per schedule of quantities and drawings shall be of perforated doubled

bend and shall be complete with tees, elbows, risers, and all necessary hardware.

- ii. Trays shall have suitable strength and rigidity to provide proper support for all the contained cables. Trays shall not have sharp edges, burrs or projections injurious to cable insulation. Trays shall include fittings for changes in direction and elevation. Cable trays and accessories shall be painted with two coats of red oxide zinc chromate primer after proper surface preparation and two finishing coats of synthetic enamel paint of approved make or as specified in BOQ. Cable trays shall have side rails or equivalent structural members.
- iii. Cable trays shall be mounted on support structure as specified by means of specified size of threaded rods and suitable fasteners. Spacing of the support structure shall be such that the cable trays shall remain perfectly horizontal without buckling when fully loaded with cable runs. The support structure shall be suspended from ceiling slab or grouted to walls in an approved manner. Width of the horizontal arms of the support structure shall be same as the tray width plus length required for threading /bolting /welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers required. Cable trays shall be bolted/ welded to the support structure. Minimum clearance between the top most tray tier and the ceiling shall be 300 mm. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. The entire cable tray system shall be rigid. Each run of cable tray shall be completed before laying of cables. Cable trays shall be erected so as to be exposed and accessible. Cables shall be fixed to the tray by clamps fabricated from minimum 3 mm thick GI sheets. The cables shall be dressed properly so as to provide minimum one cable diameter clearance between adjacent cables and from tray ends. Cable trays shall be earthed by 2 runs of 25 mm x 3 mm GI strips throughout their lengths.

5. LAYING OF CABLES

Cables shall be so laid that the maximum bending radius is 12 times the overall diameter of the cable for medium voltage cables. Cables shall be laid in masonry trenches, directly on walls/cable trays, directly buried in ground or in pipes/ducts as elaborated below. Cables of different voltages and also power and control cables shall be laid in different trenches with adequate separation. Wherever available space is restricted such that this requirement cannot be met, medium voltage cables shall be laid above HT cables. Where more than one cable is laid side by side, cable marker tags of approved type inscribed with cable identification details shall be permanently attached to cables at entry points to the building, at specified intervals for cables laid direct in grounds and in locations like manholes, pull pits etc.

6. Drawings

Shop drawings for control panels and wiring of equipment showing the route of conduit cable shall be submitted by the contractor for approval of Engineer-in-charge before starting the fabrication of panel and starting the work. On completion, all details like location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the contractor.

7. Measurement

Panels shall be counted as number of units. The quoted rate of panel shall also include all accessories, switch gear, fuses, contractor, indicating meters and lights as

per the specification. Cable tray, Power & Control cable shall be measured in running meter.

SECTION 8 Commissioning and Guarantees

1. Scope of work

The work under this section shall consist of pre-commissioning, commissioning, testing and providing guarantees for all equipment, appliances and accessories supplied and installed by the contractor under this contract.

2. General requirements:

- a. Work under this Part shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this Part
- b. Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.
- c. On award of work, contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

3. Pre commissioning

- a. On completion of the installation of all pumps, piping, valves, pipe connections, electrical wiring, motor control panels and water level controlling devices the contractor shall proceed as follows:-
 - i. Testing of M.C.C
 - ii. Tests to be carried out for motor control centres shall be:
 - iii. Insulation resistance test with 500 volt megger, before and after high voltage test, on all power and control wiring.
 - iv. High voltage test at 2000 Volts A.C. for one minute on all power and control wiring.
 - v. Low voltage continuity test (6 volts) on power wiring of each feeder, between bus bars and the outgoing terminals with switches and contactors in closed position.
 - vi. Low Voltage continuity test (6 volts) on all control wiring.
 - vii. Operation test for all feeders with only control supply made 'on' to ensure correctness of control wiring, operation of the various equipment used such as push buttons, protective devices, indicating lamps and relays etc. All contactors shall be checked and there shall be no chattering.
 - viii. Earth continuity test with voltage not exceeding 6 volts between various non-current carrying metallic parts of equipment, steel work etc. And the earth bus provided in the MCC.
 - ix. Operation of all instruments and meters provided on the MCC.

b. Pipe work

- i. Check all clamps, supports and hangers provided for the pipes.
- ii. Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant Part of the specifications. If any leakage is found, rectify the same and retest the pipes.

- iii. Check all face piping and valves
- iv. check air blower connections

4. Commissioning & testing

- a. All pumping sets

Start the duty pump on manual controls, check its operation and then test run on auto controls. Change over the duty pump and test it in the same manner as the first pump.

- b. Test runs the entire system to ensure satisfactory performance.

5. Handing Over

- a. All commissioning and testing shall be done by the contractor to the complete satisfaction of the Engineer-In-Charge and the job handed over to the Engineer-In-Charge or his authorized representative.
- b. Contractor shall also hand over, to the Engineer-In-Charge, all maintenance & operation manuals, 4 sets of As Built drawings and all other items as per the terms of the contract with soft copy.

6. Guarantees

- a. The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.
- b. The form of warranty shall be as approved by the Engineer-in-charge.
- c. The warranty shall be valid for a period of one year from the after getting virtual completion certificate.
- d. 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.
- e. 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.
- f. The contractor shall separately submit with this offer his charges per month for operation of mechanical equipment(s) after commissioning and handing over.

SECTION 9 I.S. Codes

Following codes and Indian standards shall be applicable as amended up to date-

A. Electrical equipment

- 1. Marking & arrangement for switch gear bus bars, main connections and auxiliary wiring- I.S. 375
- 2. Direct acting electrical indicating instruments - I.S.1248
- 3. Metal enclosed switch gear and control gear - I.S. 3427
- 4. A.C. Contactors of voltage not exceeding 1000 volts. - I.S. 2959
- 5. A.C. Motor starters of voltage not exceeding 1000 volts. -I.S. 1822

6. Air breaks isolation for voltages not exceeding 1000 volts -I.S. 2607
7. Heavy duty air break switches and composite unit of air break switches and fuses for voltage not exceeding 1000 volts. - I.S. 4047
8. PVC insulated cables (for voltage Up to 1100 volts with copper/ aluminium conductors) (Section I & II)- I.S. 694
9. Normal duty air break switches and composite units of air break switches and fuses for voltage not exceeding 1000 volts. -I.S. 4064
10. Code of practice for earthing - I.S. 3043
11. Pumps & motors
 - a. Centrifugal pumps -I.S. 1520
 - b. Electrical Motors - I.S.7538
12. Pipes
 - a. G.I. Pipes - I.S. 1239
13. Valves
 - a. Butterfly Valves -IS 23339/13095
 - b. Slim Type NRV -I.S. 7312
 - c. Sluice valve -I.S. 780
14. Vibration Eliminator
15. Water Shock Absorbers
16. Pipe Colour Code as per I.S. 2379-1983.

SECTION 10 Technical Information for Water Supply & Drainage Pumps to be furnished by Bidder:

- i. **Pumps**
 - a. Make
 - b. Model
 - c. Pump Discharge - Max/Min
 - d. Pump Head Min/Max,
 - e. Impeller Material
 - f. Motor HP- (Specify make, class of insulation & rated voltage \pm %)
 - g. Shaft Seal Type & make
 - h. Type of Coupling
 - i. Efficiency of Pump
 - j. Type of Bearings
 - k. RPM
- ii. **Pressure Tanks (Where specified)**
 - a. Make
 - b. Material of Construction
 - c. Internal finish
 - d. External finish
 - e. Air balloon/ diaphragm
 - f. specifications

iii. Submersible pumps- Plant Room- Sewage

- a. Make
 - b. Model No.
 - c. Pump discharge lpm - max / min
 - d. Pump head min/max,
 - e. Impeller material
 - f. Motor HP (Specify make, class of insulation & rated voltage \pm %)
 - g. Shaft seal Type & make
 - h. Type of coupling
 - i. Efficiency of pump
 - j. Type of bearings
 - k. RPM
- iv. Motor Control Centres (Give detail on separate sheets if required)**
- a. Make
 - b. Type (floor/wall mounted)
 - c. Make of switch gear
 - d. Make of meters
 - e. Make of accessories
 - f. Confirm that all switch gear starters match the capacities of pumps offered.
- v. Power & control cables**
- a. Make
- vi. Electronic Level controllers**
- a. Make
 - b. Model No.
- vii. Electronic High Water Alarm**
- a. Make
 - b. Model No.
- viii. Electronic Level Indicator**
- a. Make
 - b. Model
- ix. Pipes /CPVC**
- a. Make offered
 - i. Heavy Class 150 mm dia. & below
 - ii. Heavy Class 200 mm dia. & above
 - b. CPVC Pipe
- x. Butterfly Valves**
- a. Make
 - b. Material
 - c. Test pressure
- xi. NRV Slim Type**
- a. Make
 - b. Material
 - c. Test pressure
- xii. Vibration eliminators**
- a. Make
 - b. Material

- c. Test pressure

xiii. **Pressure**

- a. Working pressure
- b. Test pressure
- c. Filtration/holding Capacity
- d. Inlet/outlet sizes

xiv. **Painting/coating**

- a. Inside
- b. Outside

xv. **Equipment -**

Air Blower

Chlorinator

- a. Make
- b. Model
- c. Pump Discharge -Max/Min
- d. Pump Head - Min/Max,
- e. Impeller Material
- f. Motor HP (Specify make, class of insulation & rated voltage \pm %)
- g. Shaft Seal
- h. Type of Coupling
- i. Efficiency of Pump
- j. Type of Bearings
- k. Speed of Pumps

xvi. **Motor control centres**

- a. Type (floor/wall mounted)
- b. Make of switch gear
- c. Make of panel meters
- d. Confirm that all switch gear starters are of capacities for pumps offered.

- xvii. Pipe fitting scheduled.
- xviii. C.I. Pipe
- xix. RCC Pipe.
- xx. L.A. Pipe.
- xxi. HDPE Pipe.
- xxii. Insulation Material
- xxiii. Flow Meter.
- xxiv. PRV
- xxv. Hydro-pneumatic Pump.
- xxvi. Water meter.

CHAPTER D

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CHAPTER E

TECHNICAL SPECIFICATIONS - ELECTRIFICATION

SECTION 1: GENERAL DETAILS

1. Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specification / BOQ whenever it is not mentioned it shall be as given below.

- Installed out door: IP-55.
- Installed indoor in air-conditioned area: IP-52.
- Installed in covered area: IP-52.
- Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-42.
- For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

2. Rating Plates, Name Plates and Labels

Rating Plates, Name Plates and Labels shall be permanently attached to Main PCC, PCC's, MDB and auxiliaries items installed in the building, in a conspicuous position. A rating plate of non-corrosive material with engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions of equipment in question has been designed to operate and such diagram plates as may be required by the purchaser. The rating plates for all equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

3. First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/soldering/brazing material for all copper/G.I. earthing and essential chemicals etc. which will be required to put the equipment/scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

4. Finishing Of Metal Surfaces

4.1. General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be

galvanized according to IS: 2629.

4.2. Hot Dip Galvanizing

- The minimum weight of the zinc coating shall be 700 gm / sq.m and minimum thickness of coating shall be 85 microns.
- The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, splatter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- The galvanized steel shall be subjected to six one minute dips in Copper Sulphate solution as per IS-2633.
- Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
 - Coating thickness,
 - Uniformity of zinc,
 - Adhesion test,
 - Mass of zinc coating.
- Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

4.3. Painting

- All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be shopped.
- Powder coating/electrostatic painting of Siemens Gray RAL 7032 shade shall be applied.
- The exterior color of the paint shall be as per Siemens Gray RAL 7032 or as approved by Engineer-in-charge and inside shall be white or as approved by Engineer-in-charge. A small quantity of finishing paint shall be supplied for

minor touching up required at site after installation of the equipments, if required.

- In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for HLL's review and approval.

5. PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

a. DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with the following requirements:

- i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.
- ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.
- iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.
- iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.
- v) Relay wiring diagrams.
- vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.

The information furnished shall include the following:

- i) Technical literature giving complete information of the equipment.
- ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.
- iii) A comprehensive spare parts catalogue.

B. TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools with his quotation.

C. SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

D. QUALITY ASSURANCE

Quality Assurance shall follow the requirements of CLIENT/ HLL as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Client's requirements.

SECTION 10.0 L.T. CABLES & WIRE

1. **Wires**

The design manufacture, testing and supply of single core **LEAD FREE FRLS PVC** insulated 1.1 KV grade multi-stranded twisted wires under this specification shall comply with latest edition of following standards.

IS : 3961 Current rating for cables.

IS: 5831 PVC insulation and sheath of electric cables.

IS : 694 PVC insulated cables for working voltage upto and including 1100 volts.

IEC: 754(i) FRLS PVC insulated cable.

Copper multi-stranded twisted conductor FRLS PVC insulated wires shall be used in conduit as per item of work.

The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth.

Progressive automatic in line indelible, legible and sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of wire.

The material & insulation of wires shall be **ROHS compliant** (Reduction Of Hazardous Substance) and shall comply the following directives:

- EU Directive 2002/95/EC Issued Jan 2003
- EU Directive 94/62/EC and 2004/12/EC (amendment)
- EU Directive 91/338/EEC
- EU Directive 91/157/EEC & 98/101/EC (amendment)

Summary on related directives

Directive Ref.	Date	Objective	Remarks
2002/95/EC	27Jan03	Restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) and to contribute to the protection of human health and the environmentally sound recovery and disposal of waste EEE.	6 banned materials included Pb (Lead), Hg (mercury), Cr6+ (Hexavalent Chromium), Cd (Cadmium) and Flame Retardants- Polybrominated Biphenyls – PBB 1000ppm & Polybrominated Diphenyls Esters- PBDE 1000ppm. <ul style="list-style-type: none"> • <i>Max. conc. value - 0.1% by weight in homogeneous material for Pb, Hg, Cr6+, PBB/ PBDE</i> • <i>Max. conc. value - 0.01% weight in homogenous material for Cd.</i>
94/62/EC	20Dec9	Amending directive	The targets defined are the following:

2004/12/EC (amendment)	4 2Nov04	94/62/EC, on Packaging and Packaging Waste is to prevent packaging waste by encouraging packaging re-use and recycling while at the same time avoid distortions in the internal market.	<ul style="list-style-type: none"> • <i>Recovery of minimum 60% by weight of the packaging waste</i> • <i>Recycling of at least 55% and a maximum 80% by weight of the totally of packaging materials, with a material-specific minimum recycling rate for plastic of 22.5%</i> • <i>Max. sum of concentration levels of Pb, Cd, Hg and Cr6+>100 ppm by weight</i>
91/338/EEC	18Jun91	Restriction on the use of Cadmium pigment (amending for the 10th time Directive 76/769/EEC)	The cadmium content (expressed as Cd metal) exceeds 0,01 % by mass is prohibited in the finished products or components of products manufactured from polymers or copolymers of vinyl chloride and stabilized by substances.

2. Cables

The design, manufacture, testing and supply of the cable under this specification shall comply with latest edition of following standards:

- IS: 8130 Conductors for insulated electric cables and flexible cords.
- IS: 7098 XLPE insulation and sheath of electric cables.
- IS: 3975 Mild steel wires, strips and tapes for armouring cables.
- IS: 7098 Current rating of cables.
- IS: 7098 XLPE insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.

IS: 424-1475(F-3) Power cable-flammability test.

Specification for cross-linked polyethylene insulated XLPE sheathed cable for working voltage upto 1.1 KV.

Specification for XLPE insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.

ASTM-D: 2863 Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).

ASTM-D: 2843 Standard test method for measuring the density of smoke from the burning or decomposition.

IEEE : 383 Standard for type of test Class-IE, Electric cables, field splicers and connections for power generation station.

ASTME:662IEC:754(x) Standard test method for specific optical density of smoke generated by solid materials.

IS : 10418 Cable drums.

3. Technical Requirements:

- The cables shall be suitable for laying in racks, ducts, trenches conduits and under-ground buried installation with uncontrolled back fill and chances of flooding by water.
- They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.

- iii. The aluminium/copper wires used for manufacturing the cables shall be true circular/sector in shape before stranding and shall be of uniformly good quality, free from defects. The conductor used in manufacture of the cable shall be of H2 grade.
- iv. The cable should withstand 25 KA for 0.5 sec with insulation armour insulated at one end. Bidder shall furnish calculation in support of capability to withstand the earth fault currents. The current carrying capacity of armour and screen (as applicable) shall not be less than the earth fault current values and duration.
- v. The fillers and inner sheath shall be of non-hygroscopic fire retardant materials and shall be suitable for the operating temperature of the cable. Filler and inner sheath shall not stick to insulation and outer sheath.
- vi. Progressive automatic in line indelible, legible and sequential marking of the length of the cable in metres at every one metres shall be provided on the outer sheath of all cables and at every 5 metre 'FRLS' marking in case of 'FRLS' cables.
- vii. Strip/Wire armouring following method (b) mentioned in IS: 3975 shall only be acceptable. For single core cable aluminium wire armouring shall be used.
- viii. Allowable tolerance on the overall diameter of the cables shall be + 2mm.
- ix. The normal current rating of all XLPE insulated cables shall be as per IS: 7098.
- x. A distinct inner sheath shall be provided by pressure extrusion process for all multicore armoured and unarmoured cables as per IS: 5831.
- xi. Outer sheath shall be provided by extrusion process as per IS: 5831
- xii. The breaking load of armour joint shall not be less than 95% of that armour wire. Zinc rich paint shall be applied on armoured joint surface.
- xiii. In plant repairs to the cables shall not be accepted.
- xiv. All the cables shall be supplied in non-returnable drums as per IS: 10418.

3.1 In Case of FRLS Cables

- i) The outer sheath of cables shall have an oxygen index of not less than 29 as per ASIMD: 2863.
- ii) The maximum acid gas generation by weight as per IEC: 754 (i) shall not be more than 20% for outer sheath material of all cables. Bidder shall also guarantee the maximum theoretical acid gas generation with 20% by weight of outer sheath.
- iii) The cables outer sheath shall meet the requirement of light transmission of 40% (minimum and shall be tested as per ISTMD: 2843). In case the test for light transmission is conducted as per ASTM: 662. The bidder shall furnish smoke density values as per this standard and shall co-relate the anticipated light transmission when tested as per ASTM: 2843.
- iv) The cable shall pass the fire resistance test as per SS: 42, 41, 475 (I) and flammability test as per EEE: 383.

4. Inspection:

All cables shall be inspected on receipt of the same at site and checked for any damage during transit.

5. Joint in Cables

The contractor shall take care that the cables received at site are distributed to various locations in such a manner as to ensure maximum utilisation and avoidance of cable jointing. Cable shall be rechecked before cutting in lengths, where the joints are unavoidable, and the location of such joints shall be got approved from the CLIENT/ HLL. The joints shall be done by qualified jointer strictly in accordance with manufacturer's instruction/drawings.

6. Joint Boxes for Cables

The cable joint boxes shall be of appropriate size suitable for type of cable of particular voltage rating.

7. Jointing of Cables

All straight through joints shall be done in epoxy mould boxes with epoxy resins. Straight through joints shall not be permitted unless the length of run is in excess of cable drum.

End terminations of cables more than 1.1 KV grade shall be done with epoxy mould boxed and epoxy resin. Cable glands shall be 1.1KV grade double compression type and made to tin plated heavy-duty brass casting and machine finished. Glands shall be of robust construction capable of clamping cable and cable armour, firmly without injury of cable.

All washers and hardwares shall be made of brass tinned. Rubber components used in the glands shall be made of neoprene of tested quality.

Cable lugs shall be tinned copper/aluminium solderless crimping type conforming to IS: 8309 suitable for aluminium or copper conductor.

Crimping of terminals shall be done by using Corrosion inhibitory compound, with crimping tool.

Fire resistant paint has to be applied 1 Metre on either side of cable joint.

The contractor shall liaise fully with all other contractors to achieve an efficient and properly coordinated installation where equipment has to be re-positioned due to lack of site liaison; no extra cost shall be incurred by the HLL.

8. Testing of Cables

Cables shall be tested at factory as per requirement of IS: 7098 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to laying of cables, following tests shall be carried out:

- i) Insulation test between phases and phase to earth for each length of cable before and after jointing.

On completion of cable laying work, the following test shall be conducted in the presence of Engineer-in-charge/HLL/ CLIENT/ HLL.

- ii) Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.
- iii) Continuity resistance test.
- iv) Sheathing continuity test.
- v) Earth test.

9. Laying of Cable

The cable drum shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming links. At all changes

in directions in horizontal & vertical places, the cable shall be bent with a radius of bend not less than 8 times the diameter of cable.

The cable of 1.1KV grade shall be laid not less than 750 mm below ground level in a 375mm wide trench (throughout), where more than one cable is to be laid in the same trench, the width of the trench shall be increased such that the interaxial spacing between the cables except where otherwise specified shall at least be 150mm minimum or as per site requirements or as approved by the Engineer-in-charge. Where single core cables are used in multiphase systems, the cables shall be installed in trefoil where possible.

11KV and 33 KV HT cables shall be laid not less than 1200 mm below existing ground level.

In case the cables are laid in vertical formation due to unavoidable circumstance the depth per tier shall be increased by 200mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable curvature shall be i.e. either 12 times the diameter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever is less. Minimum 3-meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming 'Kinks'. The cable drum shall in-verbally convey on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Cables laid in trenches in single tier formation, 10 cms. All around sand cushioning is provided below and above the cable before a protective cover is laid. For every additional vertical tier. The 30cm of sand cushion are provided over the initial tier. The cable shall be protected by 2nd class bricks of size not less than 230x115x75mm, stone tiles/RCC curved channel be placed on top of the sand breadth wise for the full length of the cable and where more than one cable is to be laid in the same trench the brick shall cover all cables and project at least 8 cms. Over the outer sides of the end cables.

Filling of trenches shall be done after the sand cushioning and laying of tiles or bricks are carried out to the satisfaction of the Engineer-in-charge (Refer drawing). Back fill for trenches shall be filled in layer not exceeding 150 mm. Each layer shall be properly rammed & consolidate before laying the next layer.

PVC pipe shall be provided for all road crossing. The size of the pipe shall be according to the cable and a minimum 100mm dia. pipe shall be provided. The pipe shall be laid in ground with special arrangement and shall be cement jointed and concreting with 1:5:10 shall be made as per relevant IS with latest amendment. Location of cables laid directly underground shall be indicated by cable marker at an interval of 30 meters & with change of direction. Aluminium strip cable tag of 20mm wide with engraved tag no. shall be provided at both ends of cable.

Where the cables are to be laid in ducts (pucca trenches) in side the building, they will have to be laid on MS rack/ on MS cable trays grouted in walls trenches. Cables sizing through floors shall be protected from mechanical damage by a steel channel to a height of one meter above the floor where cable pass through wall they shall be sleeved with PVC/steel conduit.

Where the cables are laid in open (in building) along walls, ceiling or above false ceiling, cable rack (ladder type) or cable tray shall be provided. The size of the cable tray or rack shall depend on the number of cables to pass over that rack. Cable tray/rack shall be properly supported through wall/ceiling according to the site conditions. Cable laid on tray & riser shall be neatly dressed & clamped at an interval of 1000 mm & 750mm for horizontal & vertical cable run respectively either side at each bend of cable. All power cables shall be clamped individually & control cables shall be clamped in groups of three or four cables. Clamps for multicore cables shall be fabricated of 25x3 GI flats. Single core power cable shall be laid in trefoil formation & clamped with trefoil clamps made of PVC/fibre glass.

Cable openings in wall/floor shall be sealed by the contractor suitably by hession tape & bitumen compound or by any other proven to prevent ingress of water.

After the cables are laid, these shall be tested as per IS and the results submitted to Engineer-in-charges/Engineer and in case the results found unsatisfactory, all the repairing/ replacing of cables will be done by the contractor free of charge.

10. Quality Assurance

Quality Assurance shall follow the requirements of CLIENT/HLL as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

11. Spares for Commissioning Including Consumables

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools and consumables. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

SECTION 12 INTERNAL ELECTRICAL WORKS

1. Conducting (M.S Conduit)

All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and of 14 gauge (2 mm) for sizes higher than this. Both inner and outer surfaces shall be smooth without burrs, dents and kinks. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle. Conduit shall conform to specifications of IS: 9537 (Part-II) and the capacity of conduits shall be in accordance with the standards and shall never be exceeded. The minimum size of the conduit shall be 20mm dia. Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit shall be used.

2. PVC Conduit

All conduits shall be high impact rigid 2mm thickness PVC heavy duty type and shall comply with I.E.E. regulations for non-metallic conduit 2mm thick as per IS-9537/1983 (Part-III). All sections of conduit and relevant boxes shall be properly cleaned and glued by using epoxy resin glue and the proper connecting pieces. Inspection type conduit fittings such as inspection boxes, drawn boxes, fan boxes and outlet boxes shall be M.S. or otherwise mentioned. Conduit shall be terminated with adopter/PVC glands as required.

3. Accessories

Conduit accessories such as normal bends, unions, circular junction boxes and pull boxes, locknuts etc. shall be heavy gauge type and approved make. Conduit accessories shall conform in all respects to IS: 3837-1966 with latest amendment. Wherever several conduits are running together, adequately sized adoptable boxes common to all runs shall be used to avoid inserting inspection boxes in the individual run. Where it is necessary to segregate wiring metal filler shall be fixed with in the box.

Conduits shall be laid before casting in the upper portion of a slab or otherwise, as may be instructed or in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Vertical drops shall be buried in columns or walls. Wherever necessary, chases will be cut by the contractor with the help of chase cutting m/c or by hand. Nothing extra shall be paid to the contractor on this account. In case of exposed brick/ rubble masonry work special care shall be taken to fix the conduit and accessories in position along with the building work. Sufficient depth of the chases will be made to accommodate the required number of conduits. The chase will be filled with cement, coarse sand mortar (1:3) and properly cured by watering for one week.

If a chase is cut in an already finished surface the contractor shall fill the chase and finish it to match the existing finish. Contractor must not cut any iron bars to fix conduits. Conduits shall be kept at a minimum distance of 100mm from the pipes of other non-electrical services. Where the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting, conduits in chases shall be held by steel hooks of approved design at maximum of 100 cm centres. The embedding of conduits in walls shall be so arranged as to allow at least 12mm plaster cover the same. All threaded joints of conduit pipes shall be treated with some approved 'preservative compound' to secure protection against rust.

Suitable expansion joints fittings of approved make and design shall be provided at all the points where the conduit crosses the expansion joint in the building. (Preferably with Pilca metallic watertight conduits). Conduits shall cross at right angles of the joints only.

Separate conduit shall be used for:

- a. Normal light, fan call bell
- b. 16 A power outlets
- c. Emergency Light Point
- d. Fire alarm System
- e. LAN/ Data Network
- f. P.A. System
- g. Telephone System
- h. TV Network
- i. Access Control System
- j. Optical Fibre Cables (OFC)
- k. Or any other services not mentioned here.

Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc. shall be installed in flexible conduits. Flexible conduits shall be formed from a continuous length of spirally wound interlocked wire steel with a fused zinc coating on both sides. The conduit shall be provided with approved type adaptor. A separate and accessible earth connection shall bond across the flexible conduit.

Conduit runs on surfaces shall be supported with metal 1.2 mm thick saddles, which in turn are properly secured on to GI spacer to the wall or ceiling. Fixing screws shall be with round or cheese head and of rust proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building and shall be painted in color matching the adjoining area. Unseemly conduit bends and offsets shall be avoided by using better appearance. Cross cover of conduits shall be minimum and entire conduit installation shall be clean and with good appearance. For surface work, the boxes shall be raised back pattern type, designed for use with distance saddles to give clearance of 6mm between the back of conduit and the fixing surface.

Where conduits are run on steel work, they will be fixed by means of purpose made GI Caddy clips in manner meeting with the approval of the Engineer prior to the installation being carried out. Other methods of fixing may be agreed in special circumstances, but approval must first be obtained from the site engineer.

The spacing of saddles shall be not more than 600mm centers for up to 32mm diameter conduits and at 750mm for conduit sizes of 40mm diameter and above in case of MS conduit and not more than 600 mm for PVC conduit. In addition, saddles shall be fixed at each side of any bend/Tee, or set at a distance of 200mm from the bend/Tee. The holes in the brickwork or concrete for fixing plugs shall be neatly drilled by means of a masonry drill of the appropriate size.

All the GI sheet steel /passivated boxes used for housing switches, plugs, fan regulator etc. shall be five sided conforming to IS: 5133 Part I-1969. Suitable size of boxes shall be provided a minimum of 2 adjustable fixing lugs on vertical sides. Suitable earth terminal inside each box shall be provided. All fixing lugs shall be threaded to receive standard machined chromium plated brass screws. Sufficient number of knockouts shall be provided for conduit entry. Conduits carrying wires of

different circuit can terminate in common J.B having metal compartments. Necessary GI pull wires shall be inserted into the conduit for drawings wires. In case conduit pipe is required to cross any RCC beam special adopter boxes shall be provided for crossing & nothing shall be paid extra.

Where conduits are used for non-air-conditioned space to air-conditioned space or into a fan chamber or duct, a junction box shall be installed to break the continuity of such conduit at the point of entry or just outside and conduit shall be sealed around the conductors.

Particular care shall be taken during the progress of the work to prevent the ingress of dirt and rubbish such as plaster droppings into erected conduits. Conduit which has become so clogged shall be entirely freed from these accumulations or will be replaced. Screwed plastic or metal caps or turned wooden plugs shall be employed to protect all open ends. Plugs of waste wood, paper, cotton or other fibrous matter shall not be used. All unused conduit entries shall be blanked off in an approved manner and where conduits terminate in adaptable boxes, all removable box covers shall be firmly secured to provide complete enclosure. If considered necessary by the Engineer-in-charge, the conduits shall be swabbed out by drawing swabs of rag through the conduit to remove moisture prior to any cables being drawn in.

All conduit installations must be completed and erected in their totality before they are wired and must be fully rewirable from outlets to distribution boards or trunking systems etc. to which they connect. No wiring of any part of the installation shall be commenced until instructions are received to do so by the Engineer-in-charge at such time as he is satisfied that the wiring will not be damaged due to building operations.

Conduits shall be installed so that they are self-draining in the event of ingress of moisture due to condensation or any other reason. A suitable drainage hole shall be drilled at the bottom of the lowest conduit box in every 9-meter of horizontal run.

PVC bush of good quality shall be used in each conduit termination in a switch box, draw box, lighting fixtures and circular junction boxes.

Exposed conduits running above false ceilings shall be suitably clamped independently along with the dropped ceiling. Perforated straphangers or twisted attachment shall not be acceptable. In no case shall raceways be supported or fastened to other pipe for repair and maintenance. They shall be arranged symmetrically and in the most compact design, in no way unduly criss-crossing each other. Proper spacing shall be maintained when two or more conduits run side by side. The layout of the pipes shall be co-ordinated with other services if any. The junction boxes and conduits used in hazardous areas shall be flameproof type with cast iron construction complete with threaded covers. The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirements by means of special approved type of earthing clamp efficiently fastened to conduit pipe in a workman like manner for a perfect continuity between the earth and conduit.

The conduit system shall be so laid out that it will obviate the use of tees, elbows and sharp bends. No length of conduit shall have more than the equivalent of two-quarter bends from inlet to outlet. The conduit itself being given required smooth bend with radius of bends suiting to the site conditions but not less than 6 times overall diameter.

Outlet boxes shall be of heavy-duty sheet steel installed as to maintain continuity throughout. These shall be so protected at the time of laying that no mortar finds its way inside during concrete filling or plastering. For fluorescent fittings, the outlet

boxes heavy duty shall be provided 300mm off centre for a 1200mm fitting and 150mm off centre for a 600mm fittings or as per B.O.Q.

Draw boxes of ample dimensions shall be provided at convenient points to facilitate pulling of long runs of cables. They shall be completely concealed with MS covers flush with plasterwork painted to match the wall. These boxes will be as few as possible and located where found suitable by the HLL.

4. Switch Boxes

The switch boxes shall be zinc passivated & shall not be less than **18 SWG** thick or shall be as called for in BOQ. It will be so designed that accessories could be mounted on integral pedestals or on adjustable flat iron mounting straps with tapped holes by brass machine screw. Leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on either side of their walls. These shall be completely concealed leaving edges flush with wall surfaces. Earthing terminal inside box shall be provided.

Moulded plate switches screw less as specified in item of work shall be provided. No timber shall be used for any supports. Boxes, which come within concrete, shall be installed at the time of casting. Care shall be taken to fix the box rigidly so that its position is not shifted while concreting.

5. Wiring

All the wiring installation shall be as per IS: 732 with latest amendment. PVC insulated Fire Resistant (FR)/ Fire Resistant Low Smoke (FRLS) copper conductor cables as specified in bills of quantity shall be used for sub-circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be twisted copper conductors with thermoplastic insulations of 660/1100 volts grade. Colour Code for wiring shall be followed.

Looping system of wiring shall be used, wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors with prior permission of the HLL. No reduction of strands is permitted at terminations. No wire smaller than 1.5 sq.mm shall be used and shall be as per B.O.Q. Wherever wiring is run through trunkings or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indicating the circuit and DB number shall be used for submains sub-circuit wiring. The ferrules shall be provided at both end of each submain and sub-circuit.

Where single-phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain the wiring fed from more than one phase. In any one room in the premises where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply. Circuits fed from distinct sources of supply or from different distribution boards or through switches or MCBs shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phase, no two single-phase switches connected to different phase shall be mounted within one box.

All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.

Industrial sockets shall be of moulded plastic BoQ and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have self-adjustable spring loaded protective cap. Socket shall have MCB/ELCB/RCCB as specified in the schedule of work.

Maximum number of PVC insulated 650/1100 V grade/copper conductor cable conforming to IS: 694-1990.

Conduit size	20mm		25mm		32mm		40mm		50mm		60mm	
Wire size in sq.mm.	S	B	S	B	S	B	S	B	S	B	S	B
1.50	7	5	12	10	20	14	-	-	-	-	-	-
2.50	6	5	10	8	18	12	-	-	-	-	-	-
4	4	3	7	6	12	10	-	-	-	-	-	-
6	3	2	6	5	10	8	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	-	4	3	7	6	-	-	-	-
25	-	-	-	-	3	2	5	4	8	6	9	7

Notes:

- 1) The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
- 2) The columns heads 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns heads 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
- 3) Conduit sizes are the nominal external diametres.

List of Approved Makes of Materials

S.No	Details of equipment/ material	Make/Manufacturer
1. CIVIL WORKS		
1.	Acoustical Panelling	ECOTONE/ Viraj/ Evolution/ Armstrong/ Oceanz
2.	Adhesive for Ceramic tiles	Cico / Pidilite / Bal Endura / Laticrete/ Fosroc
3.	Adhesive for Wood Work	Fevicol/Vamicol/Dunlop
4.	Aluminium Accessories and Hardware	Classic/ Crown /EBCO /Earl Bihari
5.	Aluminium Composite Panels	Aludecor / Alucobond /Alstone
6.	Aluminium Die-Cast handles & two point locking kit	Giesse / Securistyle / Alu – alpha
7.	Aluminium Extrusion/ Sections	Hindalco / Jindal / Indal
8.	Aluminium Fabricator	To be approved by the Engineer-in-Charge
9.	Anchor Fastner	Hilti / Fischer /Bosch/ Canon
10.	Anti – Termite Treatment	It should be done by permanent members of IPCA as approved by Engineer-in-Charge.
11.	Back up rod	Supreme Industry or equivalent
12.	Ball Cock	Sant / L&T/Audco
13.	Ball valves with floats	Zoloto / Leader / Sant
14.	Batch Mix Concrete (BMC) / Ready Mix Concrete (RMC)	The contractor to install his own computerized batching plant of suitable capacity and arrange for Transit Mixers, pumps etc. as per approval of Engineer – In- Charge. Or The RMC shall be procured from the source as approved by Engineer – in Charge. RMC Producing plants of the main Cement producers shall be preferred
15.	Brass - Stop & Bib Cock	Zoloto / Sant / Jaquar
16.	C. I Pipes & Fitting	Electrosteel/ Kesoram/ NECO/ RIF/ SKF
17.	C.I Sluice Valve & Non Return Valve	Kirloskar /Leader /Zoloto/ Audco/ Sant
18.	C.I Valves (Full way, Check and Globe Valves	Leader / Kirloskar / SKF / Zolto / Sant / Castle / Kartar
19.	C.I. Manhole Covers	NECO/R.I.F./B.C./HEPCO/SKF/KAJECO
20.	C.P. Fittings Mixer / Pillar taps/ C.P brass angle valve/ Valves Washers / C.P. brass accessories/ C.P. Waste, Spreaders, Urinal	Jaquar /Marc/ Kohler/ Grohe
21.	Cement	ACC / Ultra tech / JK Cement / Jaypee-Rewa / Ambuja / Lafarge / Bangur/ Shree
22.	Cement: White	Birla White / JK
23.	Clean Room Wall Panels with/ without return air risers, Doors/ windows etc.	CLESTRA/ NICOMAC / HEMAIR / GMP / EPACK
24.	Clear Glass / Clear Float Glass / Toughened Glass	Modi / Saint Gobain (SG) / Asahi India Safety Glass Ltd
25.	Concrete Additive	CICO/ Pidilite / Fosroc / Fairmate / MC Bauchemie
26.	Curtain Rod/ Drapery Rod/ Venetian Blinds	Vista work / Mac Décor or equivalent

27.	Dash Fasteners	Hilti / Faischer / Bosch
28.	Door closer / Floor spring	Doorking / Everite / Hardwyn/ Ozone
29.	Door Locks	Godrej / Harrison / Link/ Dorma/ Ozone
30.	Door Seal – Woolpile Weather Strip	Anand Reddiplex/ Enviroseal
31.	Door Shutters- Flush	Duro / Greenlam / Century / Merino
32.	Doors & Windows Fixtures / Fitting.	Everite / Classic/ Crown / Earl Bihari
33.	Epoxy Flooring	Fosroc/ Dr. Beck/ Flamaflor
34.	Extruded Polystyrene Board	Styrofoam by DOW Chemicals / Insulboard by Supreme Industries
35.	False Ceiling - Calcium Silicate Boards & Tiles	India Gypsum/ Armstrong / Hilux / Saint Gobain (Gyproc)
36.	False Ceiling - Metal	Armstrong / Hunter-Douglas / USG/ Saint Gobain/ Unimet
37.	False Ceiling - Mineral fibre	Armstrong / Decosonic / USG/ AMF/ Saint Gobain (Gyproc)
38.	Fire Rated Doors & Frames	Navair / Shakti-Hormann / Promat / Godrej
39.	Fire Rated Glass	Asahi India Safety Glass Ltd./ Modi/ Saint Gobin
40.	Fire Retardant Paint	Viper FRS 881/ Nullifire/ Berger
41.	Fire Seal	Sealz, Alstroflam/ Abacus
42.	Fire: Door Closures, Mortice Dead locks	Becker Fire Solution/ Inersoll Rand/ Dorma
43.	Fire: D-Type Pull Handles	Becker Fire Solution/ Dorma/ Hardwin
44.	Fire: Hinges,	Becker Fire Solution/ Inersoll Rand/ Dorma.
45.	Fire: Panic Exit Devices	Becker Fire Solution/ Inersoll Rand LCN Series/ Dorma PHA Series/ D-line
46.	Fire: Sealant	Birla/ 3m/ Hilti
47.	Fire: Tower Bolts	Suzu/ Nulite, Dorset/ Dorma
48.	Floor Hardener	Pidilite / SIKKA/ Fairmate / BASF
49.	Glass : Float & Mirror	Modiguard / Atul / Saint Gobain/ Asahi India Safety Glass Ltd / Modi Glass
50.	Glass for Aluminum Doors/ Windows/ Structural Glazing	Modiguard / Saint Gobain / Pilkington/ Asahi India Safety Glass Ltd.
51.	Glass Wool / Insulation Boards	Rockwool / UP Twiga / Lloyd Insulation
52.	Grout: Non-Shrink	Fosroc / Sikka or equivalent
53.	Grouting Compound	Bal Endura/ Pidilite/ Laticrete/ Unitile
54.	Gypsum Board / Gypsum False Ceiling/ Gypsum Partitions	Boral Gypsum / India Gypsum / Lafarge / Saint Gobain (Gyproc)
55.	Laminates/ Veneers	Century/Greenlam/Formica/Sunmica/ Merino
56.	Modular Grab bars and Disabled Hardware	Dorma / D-line
57.	Modular SS Railing System	Metallica India / D – Line International Denmark / Mobel Hardware
58.	Night Latch	Godrej / Dorma/ Ozone
59.	OT: Anti-bacterial paint	Sikka by Liquid Plastic/ Viesmann/ SSK/ TRILUX
60.	OT: Conductive Tile Flooring: ESD-Control Tile Flooring	Tarkett/ Gerflor/ Armstrong/ Forbe/ Trilux
61.	Paints - Cement Based	Snowcem Plus/, Berger (Durocem Extra)/ Nerolac (Super Acrylic)/ TATA Cem
62.	Paints - Epoxy paint	ICI Dulux/ Nerolac / Cico / Sikka / BASF / Berger / Pidilite

63.	Paints - Oil Bound Distemper / Acrylic Washable Distemper	ICI Dulux/ Asian (Tractor)/ Berger (Bison)/ Nerolac (Super Acrylic)
64.	Paints - Other Paints / Primer	ICI Dulux/ Asian/ Berger/ Nerolac
65.	Paints - Plastic Emulsion Paint	ICI Dulux/ Asian/ Berger/ Nerolac
66.	Paints - Synthetic Enamel Paints	ICI Dulux (Gloss), Berger (Luxol Gold), Asian (Apolite), Goodlas Nerolac (Full gloss hard drying)
67.	Paints - Texture paint	Berger / Spectrum / Unilite Heritage /Asian
68.	Paver blocks / Tiles (All Types)	KK / Uni Stone Products (India) Pvt. Ltd/ Hindustan Tiles/ NITCO
69.	Plywood/Block board/Ply board	Duro/ Greenply/ Century/ Kitply/ National / Anchor/ Merino
70.	Polycarbonate Sheets	Galina/ GE Plastic / Vergola / Skyarch/ Polytechno/ FlexyTuff
71.	Pre-coated Galvanised Steel Sheet	Tata BlueScope / Llyod Insulations India Ltd / S.R.Metals
72.	Pre-Laminated Particle Board	Novapan /Century /Green Ply/ Merino
73.	PVC continuous fillet for periphery packing of glazings / Structural/ Glazing	Roop / Anand / Forex Plastic/ Nagalia/Trading Company
74.	PVC Doors	Sintex/ Polyex/ Rajshri
75.	PVC Flooring	Tarkett Floors / LG Floors / Gerflor / Premier Vinyl flooring / Regent / Armstrong
76.	Reinforcement Steel / Structural Steel	SAIL/ RINL/ TATA Steel Ltd./ Jindal Steel & Power Ltd./ JSW Steel Ltd.
77.	Restroom Cubicles	Merino/ Century/ Greemlam
78.	Sealant: Poly-sulphide	Pidilite / Fosroc / CICO / Sikka
79.	SFRC / RCC Manhole Covers/ Perfect RCC Grating	KK Manholes / SK Precast Concrete/ Advent concreteovision / Daya concrete
80.	Silicon sealants /Weather Sealant / Structural Glazing Sealant	GE- Silicon / Pidilite / Forsoc / Cico /Dow Corning / Sikka/ Wacker
81.	Stainless Steel	Salem Steel/ Jindal or equivalent
82.	Stainless Steel bolts, Screws, Nuts & Washers	Kundan / Puja / Atul
83.	Stainless Steel Clamps	Hilti /Intellotech Konzept or equivalent
84.	Stainless Steel CP Grating	Chilly / Camry or equivalent
85.	Stainless Steel D-handles	D-line / Giesse /Dorma
86.	Stainless Steel Friction Stay	Earl Bihari / Securistyle / EBCO
87.	Stainless Steel Hinges	Hettich/ Godrej/ Dorma
88.	Sunken Portion Treatment	Choksey / Sika / CICO/ MC Bouchemie / MC Bouchemie / BASF
89.	Super plasticizer	CICO/ Roffes Construction Chemicals/ Pidilite Industries
90.	Tiles: Ceramic Tiles	Kajaria / Nitco / HR Johnson
91.	Tiles: Glass Mosaic Tiles	Mridul / Bisazza/ Italias/ NITCO
92.	Tiles: Glazed (Ceramic) tiles	Somany / Kajaria /NITCO
93.	Tiles: Heat Resistant Terrace Tiles	Thermatek or equivalent
94.	Tiles: Vitrified Tiles (Double / Multy Charged)/ Germ free	Kajaria / Nitco /RAK /Hindware
95.	Vacuum Dewatered Flooring	Tremix / Sun Build / Avcon technics
96.	Veneered Particle Board	Duro / Greenply / Century / Novapan / Action Tesa

97.	Water Proofing Materials (Bitumenistic)	BASF/ Fosroc / Sikka / CICO / STP/ Pidilite
98.	Wooden Laminated Flooring	NITCO /Euro / Pergo
2. <u>PLUMBING & SANITARY WORKS</u>		
S.No	Details of equipment/ material	Make/Manufacturer
1.	Automatic variable temperature control / fixed temperature control faucets	Jaquar / AOS-Robo-U-Tec/ Parry / Angash / Euronics
2.	Central Control	Rain Bird, USA/Toro/Nelson,
3.	Centrifugally C.I Rainwater Intel fitting , Bronze gratings	Sages Metals, GMGR, Electro Steel , Kesoram, NECO, Neer
4.	Centrifugally casted C.I. Pipes	Neco / Hepco / Anand/ Kapilash
5.	Chlorinator	Thermax Ltd/ Watcon, Ion exchange/ Sigma DH Combine Inc./ Siemens/ Techcon/ Jesco / Prominent Heidelberg
6.	Chlorine Dosing System	Toshcon / Chloromax
7.	Cockroach Trap	Chilly/ Player/ Camry
8.	Copper Fittings (Capillary)	Yorkshire Imperial, U.K./ Rajco Metal Works Mumbai / IBP Conex Ltd.
9.	Disc Filter	Azud, Spain/ Amaid / Arkal,
10.	Ductile Iron Fittings (IS:9523)	Electrosteel/Kesoram/Tisco/Jindal
11.	Ductile Iron Pipes (IS:8329)	Electrosteel/Kesoram/Tisco/Jindal
12.	E.P.D.M Gaskets	Anand Reddiplex / Enviro Seals / HANU
13.	Forged Steel Fittings & Flanges (For Welded joints)	Rohini /Kanwal/ Vijay Cycle & Steel (VS)
14.	Geyser	Spherehot / Racold / Usha Lexus /Bajaj
15.	Hand Drier	Kopal / Utech Systems / Euronics Automat
16.	HDPE Pipes / Moulded Fittings	Emco /Polyefins/Pioneer Plyfab/ Jain
17.	HDPE Solution tank	Watcon / Ion Exchange / Water Supply Specialist Pvt. Ltd.
18.	Inbuilt Drip Line	Azud/ Rainbrid-USA/ Netafim
19.	Insulation of Hot water pipes	Vidoflex insulation / Superion insulation Kaiflex – Kaimann/Armoflex/Thermaflex
20.	Liquid Level Controllers / Indicators	Advance Auto / Sridhan International / Minilec / Radar / Femac / Switzer / 21 st Century
21.	Liquid Soap Dispenser	Euronics/Utec/Kopal
22.	MS Saddle with G.I. Riser	Harvel/Alprene/Rain Bird, USA
23.	PVC flushing cistern	Commander / Parryware / Hindware/ Cera
24.	P.R.S. Dials	Rain Bird, USA/ Toro, USA/ Nelson,
25.	P.T.M.T. Fitting	Prince India / Symet
26.	Pipe coat material (pipe protection)	RPG Raychem/Pypkote/Makphalt/Lwl
27.	Pipe Fittings: G.I.	R/Unik/Zoloto/K.S./Sun/Swastik
28.	Pipe:- G.I.	Jindal / Tata / Prakash Surya
29.	Pipes & fitting: PVC for SWR Soil, Waste & Vent Pipes and fittings, Type B PVC Casing & Screen Pipes	Prince / Supreme / Finolex
30.	Pipes & Fittings: CPVC	Flowguard/ Astral/ Ashrivad
31.	Pipes & fittings: UPVC	Finolex / Prince / Supreme / AKG / Kasta / Vector / Astral

32.	Pipes & Gully Trap: Stone ware	Perfect / R.K/ Hind / Anand
33.	Pipes and Accessories: PE-AL-PE	Kitec/ Jindal/ Kissan/Vista
34.	Pipes: Copper	Rajco Metal works, Mumbai / IBP Conex Ltd.
35.	Pipes: M.S.	Jindal / Prakash – Surya /TATA
36.	Pipes: PP-R (PN – 16)	Amitex Polymers Pvt. Ltd. / Prince/ Supreme
37.	Pipes: R.C.C	Indian Hume Pipe / Pragati Concrete Udyog Daya/KK / JSP
38.	Plastic seat cover of W.C	Commander/Hindware / Parryware
39.	Polyethylene Storage Tank	Sintex / Polycon/ Fusion
40.	Pop up Connecting Assembly	Rain Bird/Dura/Lasco,
41.	Pop up Spray Head	Rain Bird/Toro, USA/Nelson,
42.	Powder Coating Material pure Polyester	Jotun / Berger / Goodlass Nerolac
43.	PVC Water Stops	Prince /Supreme/ Finolex
44.	RQRC Hydrant	Harvel/Alprene/Rain Bird, USA
45.	RQRC Key	Harvel/ Aqua/ Drip& Drip
46.	Sensor Operated Auto Flushing System Urinals	Jaquar / AOS-Robo/U-tec/Angash/Euronics
47.	SS Gratings/ Soap Dish/Towel Rail etc.	Camry/Glacier/Gem
48.	Stainless Steel Sink	Hindware / Neelkanth / Nirali
49.	Valve Box	Rain Bird, USA/Carson Brook, USA/Dura,
50.	Valve: Air Release	Azud/ API/ Bermad/ BIR/ Kirloskar / Venus / Zoloto
51.	Valve: Butterfly	Zolato/Audco / AIP /Sant/ KSB
52.	Valve: Flush	Gem/ Jaquar / Marc
53.	Valve: Mainline Isolation	Sant /Leader /Zoloto,
54.	Valve: Pressure Relief	Omega/ Sant/Leader/ Zolato / Upadhyay / Audco
55.	Valve: Sluice / NRV	Kirloskar/IVC/Kilburn /Zoloto/Castle/ Leader / L&T/Audco
56.	Valve: Solenoid	Rain Bird, USA/Toro/Nelson,
57.	Valve: Non Return	Sant/ Leader/ Zoloto / AIP / Kirloskar/ IVC/ Leader/ Audco
58.	Valves: Gunmetal / C.P brass angle	Zoloto / Leader / Kilburn / Sant / Kartar/ AIP/ Audco
59.	VFD Pump	Jyoti / Crompton/ Kirloskar/ KSB/ Grundfos/ Mather & Platt
60.	Vibration Eliminator Resisto-flex Pads & Connections	Relay Corpn./ Kanwal
61.	Vitreous China/ Sanitary wares	Hindware / Parryware / Cera
62.	Water Cooler	Blue Star/ Voltas/ Usha/ Godrej
63.	Water Meter	Capstan / Kranti/ Anand/ Kant
64.	Water supply pumps	KSB/ Grunfos/ Kirloskar/ Crompton/ Mather & Platt
65.	White Glazed Fire Clay Sink	Hindware / Parryware / Cera
3. ELECTRICAL WORKS		
S.No	Details of equipment/ material	Make/Manufacturer
1.	MCBs / RCCB/Isolaters / RCBO / Change over switch/MCB DB	Legrand/ Schneider/ Siemens/ ABB/ L&T (Hager)/ Socomec
2.	FRLS PVC wires (Copper)	Finolex, RR Kable, Polycab, Havells

3.	Modular switch, Socket, face plate & modular box	Legrand, Siemens, Schneider, MK, WIPRO
4.	Telephone wires (FRLS)	Polycab, RR kable, Bonton , Finolex, Anchor
5.	Telephone socket	Legrand, MK, Krone
6.	PVC conduit & accessories	Avon Plast, Precision, AKG
7.	MS conduit & accessories	BEC/ AKG/ Steel Kraft
8.	Light Fixtures	Philips, WIPRO, Havells, Crompton
9.	Ceiling/Wall/Exhaust Fan	Almonard, Kaithan, Bajaj, V-Guard, Orient, Havells
10.	Casing N caping	Legrand, Modi or equivalent
11.	Octogonal street light pole	Bajaj, Wipro, Havells, Philips, Crompton, K-lite
12.	LT cable	Polycab, Havells, Universal
13.	Cable gland & lugs	Comet, Dowells, Hex
14.	Jointing Kits	Reychem, 3m birla
15.	Terminal blocks	Connectwell, Elmax
16.	MS / GI pips	TATA, JINDAL
17.	Outdoor boxes	Sintex, Hensel, Rittal

Note:-	
1.	The contractor will use one of the approved makes as approved by the HLL / Engineer -in-charge.
2.	In case of different quality / pattern of same make, the pattern/ quality shall be approved by the HLL / Engineer – in – charge.
3.	All the items included in the list or otherwise to be used in the work should conform to CPWD and relevant BIS specifications / relevant codes, as applicable.
4.	If any item is missing in the above list, its make will be decided by the HLL./ Engineer –in-charge.
5.	If any major equipment is using a small component of make other than that given as a standard component with the equipment, the same shall be accepted.
6.	Similar Makes for the same items may be used for all the subheads.