AN ISO 9001 & 14001 COMPANY

TENDER DOCUMENT

TENDER No: DLI/CON/752/569

FOR

Construction of Township (Type- I 12 nos., Type- II 10 nos. & Type- III 02 nos. Residential Qtrs.) in village, Hora Bangar, for ALIMCO Kanpur (U.P.)

VOLUME – II

Additional Conditions of Contract
&
Technical Specifications, Drawings
**ADDITIONAL CONDITIONS OF CONTRACT (ACC)**

1.0 The following Additional Conditions of Contract shall be read in conjunction with General Conditions of Contract. If there are any provisions in these Additional Conditions of Contract, which are at variance with the provisions of General Conditions of Contract, the provisions in these Additional Conditions of Contract shall take precedence.

2.0 **INTRODUCTION**

Artificial Limbs Manufacturing Corporation of India (ALIMCO), Kanpur under the Ministry of Social Justice and Empowerment, Department of Empowerment of Persons with Disabilities, Govt. of India intends to Construction of Township (Type- I 12 nos., Type- II 10 nos. & Type- III 02 nos. Residential Qtrs.) in village, Hora Bangar, for ALIMCO Kanpur (U.P.). EPI on behalf of ALIMCO has invited the NIT as an open tender from the eligible bidders as per NIT.

3.0 **APPROACHES TO WORKSITE**

The contractor shall make his own arrangement for approach to work site including borrow/ disposal area and for movement of men, materials, machineries, other equipment etc. required for carrying out the work under this contract.

The access roads/ path to the work site may not be available at all places and at all time. The contractor shall plan his work as per the availability of access roads/ path at site. All drainage of works area and all weather truck able haulage roads as required by the contractor shall be constructed and maintained during the construction period by the contractor at his own cost, including portions of the road already existing.

4.0 **WATER AND ELECTRICITY**

The contractor shall make his own arrangement for water and electrical power for construction and other purposes at his own cost and pay requisite electricity and water charges. The contractor shall also make stand by arrangements for water and electricity to ensure un-interrupted supply.

The contractor is advised to quote his rates for different works considering the above factors.

5.0 **SCOPE OF WORK INCLUDED IN THE CONTRACT**

The brief scope of work as mentioned below included in this tender shall include (but not limited to) Civil, External & Internal Electricals, Plumbing, Water supply, Fire fighting, landscaping and Horticulture etc. for Construction of Township (Type -I 12 nos., Type- II 10 nos. & Type III 02 nos. Residential Qtrs.) in village, Hora Bangar, for ALIMCO Kanpur (UP).
6.0 QUALIFICATION OF TENDERERS

To be eligible for this tender the bidders should fulfill the requirements for eligibility as mentioned in the Notice Inviting Tender (NIT) and should submit detailed data and credentials set out in Clause No. 19.0 of ITT at page no.- 5 (Vol-I), NIT of the tender. The bidders are required to fulfill all the eligibility criteria as stipulated in NIT documents and elsewhere in the Tender documents. The price bid of only those bidders who fulfill the eligibility criteria as per evaluation of EPI shall be opened. The decision of EPI/ ALIMCO in this regard shall be final & binding on the bidders.

7.0 SPECIFICATIONS

7.1 The work under the contract shall be carried out in accordance with the schedule of items of work, the particular specifications drawings forming part of this tender document, and the general conditions and other provisions of the tender.

7.2 The work in general shall be carried out as per latest CPWD specifications for Civil Works (updated with correction slips issued upto last date of submission of tender) and latest CPWD specification for electrical works (updated with correction slips issued up to last date of submission of tender) unless otherwise specified in the nomenclature of the individual item or in the particular specifications of concerned items of works.

7.3 For items not covered under latest CPWD specification, for Civil Works / latest CPWD specification for Electrical Works and in particular specification or nomenclature of the individual item as above, the work shall be done as per latest relevant BIS codes of practice.

7.4 In case specification are not covered under para 7.1 & 7.3 above the work shall be carried out as per the provisions of technical specification given in Vol. II

7.5 In case of non availability of any specification in the above paras or any overlapping provisions, non-clarity on any issue, applicability of particular provision out of above, shall be decided by Engineer-in-Charge whose decision shall be final & binding on the contractor.

7.6 Thermo Mechanically Treated bars conforming to IS: 1786, Fe 500 grade as required, from approved manufacturers viz SAIL/RINL/TISCO shall be used. The other provisions of clause 45.2 of G.C.C. remain unchanged.

The structured steel used on the works shall also be by prime manufacturers i.e. SAIL, TISCO, RINL.

7.7 Ordinary Portland Cement (OPC) as per IS:8112 shall be used in the works. In case ordinary Portland Cement will not available. The Portland Pozzolona Cement (PPC) as per IS:1489-1991 can be used and difference of price if any shall be recovered from the contractor.

7.8 Specified material viz: cement, steel, structural steel etc shall be used. Material other than specified shall be used only with prior approval of client/EPI and recovery at prevailing market rate shall be done if material other than specified used.
7.9 The contractor is responsible for executing and completing the work in accordance with the specified standards and specification and as per requirements of GOLD rating of GRIHA. Construction quality control is intended to provide a comprehensive common and consistent framework of quality control which is comprised of two main elements.

- Testing
- Inspection

7.10 The contractor shall be responsible for the types of test to be carried out, frequency of testing and stage of testing as directed by Engineer-in-charge or as stipulated in Indian Standards / CPWD Specifications for relevant works. The cost of all these tests shall deemed to be included in the item rates quoted by the contractor.

7.11 Specialized work will be carried work by the specialized agency duly approved by Engineer Incharge.

7.12 Contractor will ensure the compliance with CPWD norms, CTE, CVC and any other guidelines of Govt. of India.

7.13 Contractor shall be responsible for the consequential effects arising out of the inspection of the project by the Chief Technical Examiner Cell, Central Vigilance Commission. CAG or any other statutory body during the progress or any time after the completion of project and shall take appropriate action including submission of documentary support, records, replies etc. rectification of defective work at the risk and cost of the Contractor. Rectification of defective work/ replacement of substandard as pointed out by Chief Technical Cell, CVC, ALIMCO/ EPI or his authorized representative shall be carried out by Contractor at their own cost. ALIMCO/ EPI shall not be directly responsible to submit requisite information/ details or pay any extra amount for such type of queries/ liabilities.

8.0 Clause No.69.1 (IV) of GCC stands modified as under:

If the rates for the altered, additional or substituted work cannot be determined in the manner as specified, then the Contractor shall, within 7 days of the date of receipt of order to carry out the work, inform the Engineer-in-Charge the rates which he intends to charge for such class of work, supported by analysis of the rate or rates claimed, and the Engineer-in-Charge shall determine the rate or rates on the basis of prevailing market rates of the material, Labour, T&P etc. plus 15% (Fifteen percent) to cover the Contractors supervision, overheads and profit and pay the Contractor accordingly. The opinion of the Engineer-in-charge as to the current market rates of materials and quantum of labour involved per unit of measurements will be final and binding on the Contractor. However, the Engineer-in-Charge, by notice in writing, will be at liberty to cancel his order to carry out such class of work and arrange to carry it out in such manner, as he may consider advisable. But under no circumstances, the Contractor shall suspend the work on the plea of non-settlement of rates of items falling under the clause.
9.0 The clause No.72.1 of GCC shall be replaced as under:

The Contractor shall ensure adequate progress during the execution of work according to the detailed Bar Chart / PERT chart so that the activities are completed in the period allowed in the completion schedule as given in Additional Conditions of Contract (ACC).

However, the Contractor shall also maintain monthly progress strictly in accordance with bar chart and / or detailed time schedule that will be worked out on the basis of completion schedule for various stages in ACC. If the Contractor fails to maintain the above progress or to complete the work and clear the site on or before the contract or extended date of completion, he shall without prejudice to any other right or remedy of the EPI on account of such breach. Compensation for delay shall be charged @0.5% of the balance value of work per week of delay, subject to maximum of 10% of the balance value of work.

10.0 DISQUALIFICATION

The bidders may note that they are liable to be disqualified and not considered for the opening of Price Bid if;

a) Representation in the forms, statements and attachments submitted in the pre-qualification document are proved to be incorrect, false and misleading.

b) They have record of poor performance during the past 10 years such as abandoning the work, rescinding of contract for which the reasons are attributable to the non-performance of the contractor, inordinate delay in completion, consistent history of litigation / arbitration awarded against the contractor or any of its constituents or financial failures due to bankruptcy etc. in their ongoing / past projects.

c) They have submitted incompletely filled in formats without attaching certified supporting documents and credentials to establish their eligibility to participate in the tender.

d) If the bidders attempt to influence any member of the selection committee.

EPI reserves its right to take appropriate action including disqualification of bidder(s) as may be deemed fit and proper by EPI at any time without giving any notice to the contractor in this regard. The decision of EPI in the matter of disqualification shall be final and binding on the bidders.

11.0 EPI reserves the right to independently verify the performance of the bidder from the existing owners / users / owners’ Consultants. In case any execution of work/ Project is found to be performing unsatisfactorily, EPI reserves the right to reject the tender and price bid of such bidder shall not be opened, even if the bidder is meeting the technical and other qualifying requirements.

In such circumstances the bidder shall have no claim on EPI of whatsoever nature.

Bidder’s specific attention is drawn to above clauses.
12.0 Clause no 1.0 of Instructions to Tenders i.e. Mode of submission shall also include the following paras:

(a) The Envelope-1 shall also contain the documents meeting the eligibility criteria mentioned in “Notice Inviting Tender and “INSTRUCTIONS TO TENDERERS”.

(b) The tenderer who download the tender documents directly from EPI’s website shall have to submit tender fees of Rs. 10,000/- (Ten Thousand only) (Non-Refundable) by Crossed Demand Draft favouring “Engineering Projects (India) Ltd.”, payable at Delhi along with their bid in Envelope-1.

13.0 CLAUSE NO.1.1 OF INSTRUCTIONS TO TENDERERS as given in Page (2) of INSTRUCTIONS TO TENDERERS stands amended as below:

First the Envelope-1 of the tenderer shall be opened. Tenderers who unconditionally accept the tender conditions, deposit the required Earnest Money, meet the eligibility criteria mentioned in NIT, deposit the tender fees and whose Techno-Commercial Bid is found suitable, shall be considered for the opening of their Price Bid and Envelope-2 of such tenderers shall be opened. The Tenders not accompanied by requisite Earnest Money and/or not accompanied by the requisite tender fees and / or not conveying un-conditional acceptance of tender conditions and / or not meeting the eligibility criteria or whose Techno-Commercial Bid are not found acceptable, shall be rejected and such tenderer shall not be allowed to attend Price Bid opening i.e. opening of Envelope-2.

14.0 Bidders must submit the unpriced copy of the price bid duly stamped & signed along with other documents in the techno-commercial bid as a confirmation of having quoted for all items of the price bid.

15.0 DRAWINGS

a) Before filling in the tender, the tenderer will have to check up all drawings and schedule of quantities and will have to get the immediate clarification from EPI on any point that he feels is vague or uncertain. No claim for damages or compensation will be entertained on this account, in future.

Figured dimensions are in all cases to be followed and in no case should they be scaled. Large scale details take precedence over small scale drawing, in case of the discrepancy; the contractor is to ask for clarification before proceeding with the work.

b) The drawings attached to the tender documents provide a general idea about the work to be performed under the scope of this contract. These are preliminary drawings for tender purpose only and are by no means the final/GFC drawings and may not be showing the full range of the work under the scope. The details given in the tender drawings are tentative and likely to be changed / modified during the detailed engineering.
c) The work has to be executed according to “Good for Construction” drawings issued by Engineer-in-charge with addition and modifications made from time to time as and when required and approved by Engineer-in-charge. The drawing shall be progressively released to site before the start of the corresponding work.

Before the commencement of any item of work, the contractor shall correlate all the relevant architectural and structural drawings issued for the work and satisfy himself that the information available there from is complete and unambiguous. The discrepancy, if any, shall be brought to the notice of Engineer-In-Charge before the execution of work. The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and/or incomplete information. Nothing extra shall be paid on this account.

16.0 SITE LABORATORY

As part of the contract the contractor shall provide and maintain a site laboratory for the routine testing of construction material under the direction and general supervision of Engineer-in-charge. The laboratory room shall be constructed and installed with the appropriate facilities. Temperature and humidity controls shall be made available wherever necessary during the testing of samples.

All equipments shall be provided by the contractor so as to be compatible with the specified testing requirements. The contractor shall maintain the equipment in good working conditions for the duration of the contract.

The Contractor shall provide approved qualified personnel to run the laboratory for the duration of the contract. The number of staff and equipment available must at all times be sufficient to keep pace with the sampling and testing programme as required by Engineer-in-charge. The laboratory Incharge of the contractor shall report to Engineer-in-charge.

The Contractor shall fully service the site laboratory and shall supply everything necessary for its proper functioning, including all transport needed to move equipment and samples to and from sampling points on the site etc.

The Contractor shall re-calibrate all measuring devices whenever so required by the Engineer-in-charge and shall submit the results of such measurements without delay.

For all other tests as required by Engineer-in-charge, the Contractor shall get the same carried out / conducted by approved testing Laboratory. In addition if, EPI / ALIMCO feels, may direct the Contractor to conduct the tests in the presence of EPI/ALIMCO representative at site lab / outside labs. All expenses payable for transport of samples and conduction of tests shall be borne by the contractor.
17.0 VARIATION IN TAXES, DUTIES, LEVIES & IMPOSITION OF NEW TAXES ETC:

i) The price bid shall be inclusive of work contract tax / VAT / GST / Labour Cess or any other tax levied on the transfer of property and goods involved in the “Works Contract” in accordance with the relevant Act in the State Act and rules made there under including amendments, if any. The liability on account of such tax as per the rates of tax prevailing as on seven days prior to last date of bid submission shall be included in the price bid. In case of any variation in the rates of tax after this date, the same shall be paid / recovered from the contractor subject to the submission of documentary evidence and proof of having made the payment at the revised rate.

ii) The price bid shall also be inclusive of Service tax, if applicable on Construction Service as per the rates prevailing as on seven (7) days prior to the last date of submission of tender (including abatement as applicable). In case of any variation in the rate of Service Tax, after this date, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition / deduction to the Contract Price.

iii) If a new tax, duty or levy is imposed under statute or law in India after the date seven (7) days prior to the last date of submission of tender and the contractor becomes liable there under to pay and actually pays the said new tax, duty or levy for bonafide use on the works contracted, the same shall be reimbursed to the contractor against documentary evidence of proof of payment, provided that the amount thus claimed is not paid / payable under price variation provision of the Contract.

iv) The payment / reimbursement of statutory variations in the rates of tax and / or of new tax, duty or levy imposed under statute or law in India as per para (i), (ii) & (iii) above, would be restricted only to direct transaction between the EPI and the Contractor.

v) Rates shall remain firm till completion of entire works and shall be inclusive of all taxes, Entry tax, duties, Octroi, Royalties, VAT / WCT/GST or any other similar tax in the state concerned, Labour Cess and other levies etc. as applicable.

18.0 PRICE VARIATION

No price variation is allowed in this contract since it is a firm rate contract till completion of work.

19.0 FINAL BILL

The final bill will be submitted by the contractor within 90 days from the date of acceptance of completion of work accompanied by the following documents.

a) Interim Completion certificate issued by the Engineer-in-charge specifying the handing over of the work including list of inventories (fittings & fixtures).

b) Computerized stage wise payment schedule.
c) No claim certificate by the contractor.

d) No claim certificate from the sub agencies / venders engaged by the contractor.

e) ‘As built’ drawings.

f) Periodical services and measurement books.

g) Drawings for layout of underground cables and details showing location of sluice valves, electric cable joints etc.

h) All operation and maintenance manuals.

i) All statutory approvals from various state / central govt. local bodies, if required for completion & handling over of the work as included in scope of contractor.

j) Manufacture’s guarantee of various machines / equipments installed as part of works.

20.0 For dispatch of materials to site, equipment manufacturer / supplier shall mark consignee as self A/c Artificial Limbs Manufacturing Corporation of India (ALIMCO) through Engineering Projects (India) Ltd (EPI).

21.0 GENERAL

21.1 Flooring works shall be executed as per the approved drawings / design & specifications. The pattern shown in the tender drawings, if any, can be modified as per the site requirements by Engineer-in-Charge within the proportions of the flooring materials to be provided and nothing extra whatsoever shall be payable over and above the rate quoted.

21.2 The water proofing for the terraces, underground tanks / toilet floor etc. shall be got executed only through the authorized applicators of the manufacturers and the guarantee for the same shall be in the name of EPI / owner for a period of ten years after the expiry of defect period liability on the prescribed format given in the GCC.

21.3 Plumbing & Sanitary work to be executed by licensed plumber and the plumbing scheme / drawing to be got approved from statutory authorities through the appointed licensed plumber without any extra cost. The agency shall have to submit the valid license of plumbers before starting the work.

21.4 SCI pipes for sanitary and GI pipes for water supply if fixed in RCC members like columns, beams etc. shall be fixed with scrub plugs.

21.5 The contractor shall be responsible for all protection of sanitary, water supply, electrical fittings & fixture against pilferage, breakage during period of installation until the completion of work and handed over to EPI.
21.6 Welding wherever required in the work like in grill, railing etc shall be done in full length of the contact area and grinding shall be done properly to get an even surface. SFRC covers for manholes etc, if provided, shall have name of owner / client and year of manufacturer as engraved.

21.7 The electrical works shall be executed only through licensed electrician and the agency shall have to submit the valid license of electricians before starting the work.

21.8 It will be the sole responsibility of contractor to obtain all statutory approvals / compliance required for construction / implementation of the project including right of way Forest clearance and completion clearance from the all relevant statutory bodies for plumbing, sewerage, sanitary and PHE work, fire department for fire protection, fire fighting, fire fighting installation, electrical works etc. and for all other services as included in the scope of contract etc. from the concerned department as required within the stipulated time frame. Liaison work on behalf of EPI / owner with the local bodies will also have to be done by the contractor. Nothing extra shall be payable to contractor on this account.

21.9 The contractor shall erect MS sheet fencing along the periphery of the site as per drawing of EPI with proper colour as directed by the Engineer-in-Charge and name / logo, safety slogan etc. written at appropriate places within ten days of issue of LOI. The contractor shall be responsible for daily cleaning of this fencing with water etc. to keep the fencing in neat & clean condition at all times. The damaged fencing should be replaced immediately by the contractor. The cost of MS sheet fencing, its maintenance etc. is deemed to be included in the quoted rates. The contractor shall engage sufficient number of security guards at his cost to ensure controlled entry to site and not to allow unauthorized personnel at site.

21.10 The tenderers shall make necessary safety arrangements at site including as mentioned in GCC and indemnify EPI against any consequence of accident at site.

EPI is awarding this Contract on behalf of ALIMCO. In case M/s. EPI cease to be an agency for the project, the right and responsibility etc. of EPI in the Contract shall get transferred to ALIMCO or their nominated agency shall operate this Contract.

22.0 ROAD PERMIT

Road permit for transportation of goods across state border shall not be issued by ALIMCO / EPI and will have to be arranged by contractor on his own. Transit Insurance of the equipment shall be arranged by the contractor. Nothing extra shall be paid on this account.

23.0 Invoice should be raised by Contractor in the name of Engineering Projects (India) Ltd., at Project Site Office.
24.0 MOBILIZATION ADVANCE

Interest bearing Mobilization Advance is applicable in this contract as clause no 8.0 of GCC. The recovery of Mobilization Advance paid shall be commenced after @10% of work is completed and the entire amount together with interest shall be recovered by the time 80% of work shall be completed.

25.0 CLAUSE NO. 72.4.1 (TIME ESSENCE OF CONTRACT & EXTENSION FOR DELAY) OF GCC STANDS MODIFIED AS UNDER

As the completion time is the essence of the contract, Agency may require additional resources, men & machinery, which has to be considered while quoting.

Within 10 (Ten) days of date of Letter of Intent, the contractor shall submit a Time and Progress Chart (CPM/PERT/Quantified Bar Chart) and get it approved by the Engineer-in-Charge. The Chart shall be prepared in direct relation to the time stated in the contract documents for completion of items / scope of the works. It shall indicate the forecast (milestones) of the dates of commencement and completion of various items trades, sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the contract documents, to ensure good progress during the execution of the work. The approval by the Engineer-in-Charge of such programme including modifications made by the Engineer-in-Charge in the said programme shall not relieve the contractor of any of his duties or responsibilities under the contract. This is without prejudice to the right of Engineer-in-Charge to take action against the contractor as per terms and conditions of the agreement.

The physical report including photographs shall be submitted by the contractor on the prescribed format & the intervals (not later than a month) as decided by the Engineer-in-Charge. The compensation for delay as per clause 72.1 as above shall be leviable in case the required progress is not achieved to meet the time deadlines of the completion period for execution of the complete work as per scope of work.

In case entire work is completed within the total time period of completion or extended period of completion allowed, the compensation for delay due to not achieving progress at intermediates stage, if any, shall be refunded without any interest charges.

26.0 PLANT AND MACHINERY

All plant & machinery required for execution of work shall have to be arranged by the contractor at his own cost. However, the contractor has to deploy following minimum plant & machinery in good condition at site immediately after award of work.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Minimum Number Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Total station for surveying work.</td>
<td>One</td>
</tr>
<tr>
<td>2.</td>
<td>Vibrators (Petrol / Electrical)</td>
<td>Six</td>
</tr>
<tr>
<td>3.</td>
<td>Needles of Vibrator</td>
<td>Twelve</td>
</tr>
</tbody>
</table>
4. Excavator/Poclain | One
5. Tipper / Dumper (3 cum.) | Two
6. DG Set (63 KVA & 125 KVA) | One Each
7. Leveling Instruments | One
8. Water Tanker | Two
9. Concrete Mixture machine with weigh batcher 14/10 capacity | Two
10. Tractor with trolley for transportation of material | One
11. The agency shall provide sufficient area lighting for the safe execution of works during night hours through static / mobile arrangements. | As per requirement of site
12. Laboratory equipments | As required

**Note:**

a) In addition to above contractor has to arrange sufficient plant & machineries to complete the work as per completion schedule.

b) Any other equipment for site test as outlined in CPWD / BIS specification and as directed by the Engineer-in-charge.

c) The quantities of equipments mentioned above are indicative only and can be increased as per the requirement of quantum work OR as per the direction of Engineer-in-Charge. The above equipment list is indicative and not complete. The contractor has to deploy all the required equipment to complete all the works within stipulated specifications and time period as per contract documents.

d) The contractor will not be allowed to take out equipments from the site without the written permission of Engineer-in-charge.

e) In the event of breakdown of any equipment the contractor should immediately mobilize replacement of the said equipment.

**27.0 CENTERING & SHUTTERING**

27.1 Centering & shuttering works for columns shall be made out of laminated shuttering plywood of minimum 12mm thickness as per BIS, with angle iron frame. The staging system shall be got approved from the Engineer-in-charge. Scaffolding of latest materials/round steel pipes with couplers and brackets shall be used. Wooden planks, props, ballies etc are not permitted for use and steel plate shuttering is also not permitted.

27.2 The shuttering used for beam shall be of laminated shuttering plywood as per BIS. The support system shall be integrated with the slab. For slabs in case ply wood shutters is not used,( because of site or practical consideration) welded steel plates will be allowed to be placed in uniform pattern. The thickness of plates and pattern to be got approved from the Engineer-in-charge.
27.3 All joints in the shuttering i.e. plate to plate etc shall have to be sealed with adhesive / foam, to ensure water tightness of the form work.

27.4 All shuttering work for Architect features shall be with fiber glass moulds and the rate quoted by the contractor in the schedule of rate shall be inclusive of same.

27.5 All shuttering joints in the slab, beams and lintels etc. shall be treated with tape of required width to make it water tight and the rates quoted for centering shuttering work shall be all inclusive and nothing extra whatsoever shall be payable over and above the quoted price.

27.6 The shuttering shall be tightened by using runners, tie rods and bracings. No Ghughoo / welded system shall be allowed. Support shall be adequate and proper.

28.0 CONCRETING

28.1 The concreting shall be done by mixture machine with weigh batcher 14/10 hr capacity.

28.2 Alternatively, the contractor may opt to use Ready Mixed Concrete (within 50km distance from the site of work) of repute after obtaining prior written approval from the Engineer-in-charge at his own cost. No extra payment shall be made on this account.

Ready mix concrete brought from outside sources or produced at site shall have minimum quantity of cement as specified in BIS specifications and as per approved design mix

28.3 The batching plant of minimum capacity of 30cum./hr. with a least count of 0.5kg, drum type four load cells, computer compatible print out for each batch only shall be allowed.

28.4 The concreting shall be placed by concrete pumps of required capacity. Concreting by crane and buckets will be allowed in rare case with the prior approval of Engineer-in-charge.

28.5 The contractor shall provide construction joints only at the specified positions and as per BIS codes and the concreting for columns shall be floor to beam height in one lifts, and in case the concreting is to be done in two lifts the minimum height of first lift of columns shall be 2.4 meters.

28.6 The stone aggregate and sand of required zone shall be from the quarries as approved by Engineer-in-charge. The samples of the materials shall be got approved along with the mix design.

28.7 Plasticizers of the required specification and make shall only be permitted as per approved mix design.

28.8 The contractor shall provide all cut outs in RCC work in co-ordination with other agencies and as per instructions of Engineer-in-charge and nothing extra shall be
payable. In case the same is not provided by the contractor the same shall be got done at their risk and cost.

28.9 To ensure proper cover, only factory made approved cover blocks will be used to avoid displacement of bars in any direction.

28.10 The steel bars of different diameter should be stored about 30-45 cm. above ground level or on concrete surface to avoid corrosion of steel. No extra payment shall be made on this account.

29.0 DESIGN MIX CONCRETE

29.1 Design mix concrete shall be used in the work for all structural members. For design mix, CPWD specification along with relevant IS codes shall be followed in general along with the specific provisions made herein.

29.2 All parameters shall be adopted for design mix as per latest relevant BIS code.

29.3 Approved admixtures conforming to latest relevant IS code shall be permitted to be used. The chloride content in the admixture shall satisfy the requirement of latest IS code. The total amount of chloride content in the admixture mixed concrete shall satisfy the requirement of latest IS code.

29.4 The concrete mix design with and without admixture will be carried out by the contractor through one of the following laboratories/ Test houses to be approved by Engineer-in-charge.

- IIT, NIT only

29.5 In the event of all the above laboratories being unable to carry out the requisite design/ testing, the contractor shall have to get the same done from any other reputed laboratory with prior approval of the Engineer-in-charge.

29.6 The various ingredients for mix design/ laboratory tests shall be sent to the lab/test houses through the Engineer-in-charge and the samples 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.

29.7 The contractor shall submit the mix design report from approved laboratory for approval of Engineer-in-charge within 45 days from the date of issue of letter of acceptance of the tender. No concreting shall be done until the mix design is approved.

29.8 The contractor shall make cubes of trial mixes as per approved mix design for all grades of concrete in presence of the Engineer in charge using same ingredients as adopted for design mix, prior to commencement of concreting and get them tested in presence of Engineer-in-charge for 7 days and 28 days. For each design mix, a set of six cubes shall be prepared from each of the three consecutive batches. Three cubes from each set shall be tested at the age of 7 days and three cubes at the age...
of 28 days. The cubes shall be made, cured, transported and tested strictly in accordance with CPWD specifications. The average strength of nine cubes at the age of 28 days shall exceed the specified target mean strength for which design mix has been approved.

29.9 80% of the total tests shall be done at the laboratory established at site by the contractor and remaining 20% in the approved laboratory as directed by Engineer-in-Charge and the testing charges of the samples shall be borne by the contractor.

29.10 For each change of source or quality/characteristic properties of the ingredients from that approved & used in the concrete mix during the work, a fresh mix design shall be got done by the contractor. Revised trial mix test shall be conducted at laboratory established at site/ reputed Laboratory with prior approval of Engineer-in-charge and shall be submitted by the contractor as per the direction of engineer-in-charge.

29.11 The cost of packaging, sealing, transportation, loading & unloading cost of all samples-concrete /cubes/ steel/ other material etc and the testing charges for mix design in all cases shall be borne by the contractor.

30.0 COMPLETION SCHEDULE

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Period from the date of Start</th>
<th>Cumulative Value as a percentage of total value of work to be completed till the end of period specified under Column No. 2 (Milestone)</th>
<th>Description of work to be completed during the period specified under column no. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>From the date of start to the end of 3rd month.</td>
<td>30%</td>
<td>Completion of foundation upto plinth level.</td>
</tr>
<tr>
<td>2</td>
<td>From the start of 4th month to the end of 8th month.</td>
<td>70%</td>
<td>Completion of structure/brick work of all buildings and Completion of 50% flooring, plastering, internal services of electrical and start of other services.</td>
</tr>
<tr>
<td>3</td>
<td>From the start of 9th month to the end of 10th month.</td>
<td>90%</td>
<td>Completion of all balance civil work including electrical, plumbing etc.</td>
</tr>
<tr>
<td>4</td>
<td>From the start of 11th month to the end of 12th month.</td>
<td>100%</td>
<td>Finishing of all the work and finally handing over the project to Client.</td>
</tr>
</tbody>
</table>
Note: In case of mismatch in financial and physical progress as above at any milestone stage, the financial progress shall be considered for levy of compensation of delay, if any. All infrastructural development works shall be completed within the stipulated time frame.

31.0 The contractor shall comply with legal orders, directions and by laws of local bodies / authorities. The contractor shall give to the Municipality, Police, Local Bodies and concerned Governmental authorities all necessary notices relating to works that may be required under the law and obtain all requisite licenses, permissions for temporary obstructions, enclosures, collection and stacking of materials, etc. The contractor shall pay at his own cost all fees, taxes and charges that may be liable on account of these operations in executing the contract. Nothing extra shall be paid by EPI on this account.

The contractor shall be bound to follow the instructions and restrictions imposed by the administration / Police authorities on the working and / or movement of labour, materials etc. nothing extra shall be payable due to less / restricted working hours at site or any detours in movement of vehicles.

32.0 INSPECTION, TESTING AND ACCEPTANCE

32.1 TEST CERTIFICATE

All manufacturer’s certificates of test showing that the all equipments/ materials have been tested in accordance with the requirements of the relevant standard specification and the copy of the test certificate as well as standard shall be supplied free of cost to EPI/ALIMCO.

33.0 GUARANTEE

The contractor shall also guarantee the performance of individual equipment.

34.0 INSURANCE UNDER WORKMEN COMPENSATION ACT

The clause '18.0' (Insurance Under WCA) at page 22 of General Conditions of Contract (GCC shall be replaced and read as under:

Contractor is required to take insurance cover under the workmen compensation Act, 1923 amended from time to time from an approved insurance company and pay premium charges thereof. Wherever required by EPI, the contractor shall produce the policy or the policies of Insurance and the receipt of payment of current premium. In the event of an accident, any workmen employed by the contractor for execution of the works, suffers an injury or death and is to be compensated under the provisions sub-section (1) of section 12, of the workmen’s Compensation Act, 1923 by the contractor and if the contractor fails to compensate, the EPI / ALIMCO shall be entitled to recover from the contractor the amount of the compensation so paid, without prejudice to the rights of the EPI / ALIMCO under section 12, sub-section (2), of the said Act.
EPI / ALIMCO shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due to the Contractor whether under this contract or otherwise. EPI / ALIMCO shall not be bound to contest any claim made against it under sub-section (1) Section 12, of the said Act, except security for all cost for which EPI / ALIMCO might become liable in consequence of contesting such claim.

35.0 INSURANCE OF WORKS

The Insurance coverage as stipulated in General Conditions of Contract (GCC) clause no. 17 (Insurance of works), clause no. 18 (Insurance under WCA) and clause no. 19 (Third Party Insurance) shall be in the joint name of ALIMCO, EPI and the Contractor for the contract period and 24 months after Successful completion / handling over of work. The Insurance coverage shall be on the total value of work awarded to contractor by EPI.

36.0 CLAUSE NO. 35.0 OF GCC (SECURED ADVANCE AGAINST NON-PERISHABLE MATERIALS) STANDS DELETED.

37.0 PERMITS AND INSPECTIONS

The contractor shall obtain all necessary permits from local bodies, provincial or central authorities and shall make arrangement for inspection and tests etc. as required at his own cost.

The contractor shall have to make his own arrangements for getting the permission for plying trucks or any Plant & Equipment for execution of works from the Police Department/ Govt. authorities at his own cost. No excuse as to delay in work due to non-availability of permission shall be entertained.

38.0 LICENSES

The contractor shall arrange for obtaining the license and clearances for the operation. (If required) from the local authorities and statutory bodies at his own cost & nothing extra shall be payable. Certification of various equipments / installations from statutory bodies other agencies as required as per technical specifications, shall be arranged by contractor at his own cost before handing over.

39.0 The work shall be carried out in accordance with the drawings/documents approved by the EPI / ALIMCO. Before the commencement of any item of work, the contractor shall correlate all the relevant architectural and structural drawings issued for the work and satisfy himself that the information available there from is complete and unambiguous. The discrepancy, if any, shall be brought to the notice of Engineer-In-Charge before carrying out surveying work. The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and / or incomplete information. Nothing extra shall be paid on this account.
40.0 The contractor shall be bound to sign the site order book as and when required by Engineer-In-Charge at Site and carry out compliance of instruction promptly to the satisfaction of Engineer-In-Charge.

41.0 Bill of Quantities shall be read in conjunction with the specifications and requirement described in tender documents, Instructions to tenderers, General conditions of contract, Additional conditions of contract, Technical specifications, Drawings, Schedules, and Annexure & Addendum etc. to tender document.

General directions and description of work and materials are not necessarily repeated or summarized in the Bill of quantities. Reference to the relevant sections of the contract document shall be made by the contractor before entering rates or prices against each item in the Bill of Quantities.

42.0 SITE ENGINEER OF CONTRACTOR

The Contractor shall employ at his cost the adequate number of technical staff during the execution of this work depending upon the requirement of work. For this purpose the number of staff to be deployed, their qualification, experience as decided by EPI shall be final and binding on Contractor. The Contractor shall not be entitled for any extra payment in this regard. The technical staff should be deployed on full time basis & available at Site, whenever required by EPI to take instructions.

However, Minimum qualifications and experience required for principal technical rep. and other minimum technical staff other than supervisor is given below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Qualification</th>
<th>No.</th>
<th>Minimum Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Graduate Civil Engineer/Engineer – As a Principal Technical Representative/Project-in-charge</td>
<td>1</td>
<td>Atleast 20 year experience in execution of reputed project of multi-storey residential / non residential buildings / institutional buildings including external development work etc.</td>
</tr>
<tr>
<td>2.</td>
<td>Graduate Civil Engineer/Engineer – As a Project Manager</td>
<td>1</td>
<td>Atleast 10 year experience in execution of reputed project of multi-storey residential / non residential buildings / institute etc.</td>
</tr>
<tr>
<td>3.</td>
<td>Diploma Engineer (Civil) as a Site Engineer for execution of civil work.</td>
<td>2</td>
<td>Minimum 5 years experience in execution of multi-storey residential / non residential buildings / institute etc.</td>
</tr>
<tr>
<td>4.</td>
<td>Graduate/Diploma (Electrical) as a Site Engineer for execution of electrical work.</td>
<td>1</td>
<td>Atleast 5-8 year experience in execution of electrical work in multi-storey residential / non residential buildings / institute etc.</td>
</tr>
<tr>
<td>5.</td>
<td>Graduate Civil Engineer for QA &amp; QC work as a Incharge of Site Laboratory.</td>
<td>1</td>
<td>Atleast 8-10 year relevant experience in QC/QA work of institutional &amp; residential building.</td>
</tr>
</tbody>
</table>
6. **Surveyor with Diploma in Surveying for Site surveying work.**

<table>
<thead>
<tr>
<th>Experience</th>
<th>Graduate /degree holder (INR P.M)</th>
<th>Diploma holder (INR P.M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20 years</td>
<td>1,00,000</td>
</tr>
<tr>
<td>2</td>
<td>10 years</td>
<td>70,000</td>
</tr>
<tr>
<td>3</td>
<td>8-10 years</td>
<td>60,000</td>
</tr>
<tr>
<td>4</td>
<td>5-8 years</td>
<td>50,000</td>
</tr>
<tr>
<td>5</td>
<td>5 years</td>
<td>45,000</td>
</tr>
<tr>
<td>6</td>
<td>Without experience</td>
<td>30,000</td>
</tr>
</tbody>
</table>

7. **Graduate/ Diploma Engineer as a Site Safety Engineer**

<table>
<thead>
<tr>
<th>Experience</th>
<th>Graduate /degree holder (INR P.M)</th>
<th>Diploma holder (INR P.M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimum 5 years experience in Surveying work of hilly terrain using total station.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Minimum 5 years experience in safety work of multi-storey residential / non residential buildings / institute etc.</td>
<td></td>
</tr>
</tbody>
</table>

If Contractor fails to deploy minimum Technical staff as mentioned above, recovery on account of non-deployment of each Technical staff shall be made from subsequent RA Bills as under:

<table>
<thead>
<tr>
<th>Si No</th>
<th>Experience</th>
<th>Graduate /degree holder (INR P.M)</th>
<th>Diploma holder (INR P.M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20 years</td>
<td>1,00,000</td>
<td>70,000</td>
</tr>
<tr>
<td>2</td>
<td>10 years</td>
<td>70,000</td>
<td>45,000</td>
</tr>
<tr>
<td>3</td>
<td>8-10 years</td>
<td>60,000</td>
<td>40,000</td>
</tr>
<tr>
<td>4</td>
<td>5-8 years</td>
<td>50,000</td>
<td>35,000</td>
</tr>
<tr>
<td>5</td>
<td>5 years</td>
<td>45,000</td>
<td>30,000</td>
</tr>
<tr>
<td>6</td>
<td>Without experience</td>
<td>30,000</td>
<td>---------</td>
</tr>
</tbody>
</table>

43.0 **COMPLETION AND TAKING OVER**

As soon as the project is finally completed, the contractor shall inform EPI shall in turn inform to (ALIMCO). ALIMCO shall nominate a committee / officers for checking / verifications of completed work as per the scope of work for final taking over the project.

44.0 **ISO COMPLIANCE**


45.0 **FACILITIES**

The sub-clause 28.3 of the clause no. 28 of General Conditions of Contract (GCC) for Furnished Office Accommodation & Mobility and Communication to be Provided by Contractor to EPI shall be replaced and read as under:-

The contractor shall make his rates in Bill of Quantities sufficiently comprehensive to
cover the cost of the facilities as per details shown below and the contractor shall not be entitled for any extra payment for the same.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A). CONVEYANCE AND OTHER FACILITIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle (Brand New) Four wheel drive Renault Duster vehicle or equivalent with Driver and accessories.</td>
<td>No</td>
<td>1</td>
</tr>
<tr>
<td>Monthly running shall be restricted to 4000 Kms each.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B) Office Boy Cum-Cook on full time basis for EPI</strong></td>
<td>Nos.</td>
<td>2</td>
</tr>
</tbody>
</table>

The vehicle shall be brand new and shall be provided with driver on full time basis. Consumables like diesel/petrol/oil lubricants and spare parts etc. shall be provided by the Tenderer at their cost. The vehicles shall be maintained in good working condition. In case of breakdown, replacement of vehicle shall be provided by Tenderer. In case a vehicle is not required by EPI, a recovery of Rs. 50,000/- per month per vehicle shall be made from the Tenderer for this purpose till the completion of project.

In case Driver, POL, maintenance of any vehicle is not required by EPI for any vehicle, a recovery of Rs. 50,000.00 per month per vehicle shall be made from the Tenderer for this purpose till the completion of project.

The Tenderer shall provide ‘Sign Board(s)’ as per design approved by EPI and/or Client.

In case the above facilities are not provided by the Tenderer within 10 (ten) days of award of work or replacement is not provided within the specified period, EPI shall arrange the same at the risk and cost of the PARTY and make the recoveries from the bills of the Tenderer for the same. The decision of EPI shall be final and binding on the Tenderer in this regard.

**48.0** The Contractor shall furnish details whether they are covered under micro, small and Medium Enterprise Development Act 2006. If yes, clearly indicate under which category they are covered along with documentary evidence. This information is required to be furnished along with the bid.

**49.0** ARBITRATION: Modification of arbitration’s clause no 76.0 of GCC

General Conditions of Contract (GCC) Sub Clause no.76.1 and 76.3 of Arbitration Clause no.76.0 are amended as given below. Sub Clause no.76.2 will remain the same.

**76.0** ARBITRATION

Before resorting to arbitration as per the clause given below, the parties if they so agree may explore the possibility of conciliation as per the provisions of Part III of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015. When such conciliation has failed, the parties shall adopt the following procedure for arbitration:
i) Except where otherwise provided for in the contract, any disputes and differences relating to the meaning of the Specifications, Design, Drawing and Instructions herein before mentioned and as to the quality of workmanship or materials used in the work or as to any other questions, claim, right, matter or things whatsoever in any way arising out of or relating to the Contract, Designs, Drawings, Specifications, Estimates, Instructions, or these conditions or otherwise concerning the works of the execution or failure to execute the same whether arising during the progress of the work or after the completion or abandonment thereof shall be referred to the Sole Arbitrator appointed by the Chairman & Managing Director (CMD) of Engineering Projects (India) Limited (EPI) or any other person discharging the functions of CMD of EPI. The person approached for appointment as Arbitrator shall disclose in writing circumstances, in terms of Sub-Section (1) of Section (12) of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015 as follows:

a) such as the existence either direct or indirect, of any past or present relationship with or interest in any of the parties or in relation to the subject-matter in dispute, whether financial, business, professional or other kind, which is likely to give rise to justifiable doubts as to his independence or impartiality; and

b) which are likely to affect his ability to devote sufficient time to the arbitration and in particular his ability to complete the entire arbitration within a period of twelve months.

The Arbitrator shall be appointed within 30 days of the receipt of letter of invocation of arbitration duly satisfying the requirements of this clause.

ii) if the arbitrator so appointed resigns or is unable or unwilling to act due to any reason whatsoever, or dies, the Chairman & Managing Director aforesaid or in his absence the person discharging the duties of the CMD of EPI may appoint a new arbitrator in accordance with these terms and conditions of the contract, to act in his place and the new arbitrator so appointed may proceed from the stage at which it was left by his predecessor.

iii) It is a term of the contract that the party invoking the arbitration shall specify the dispute/ differences or questions to be referred to the Arbitrator under this clause together with the amounts claimed in respect of each dispute.

iv) The Arbitrator may proceed with the arbitration ex-parte, if either party, in spite of a notice from the arbitrator, fails to take part in the proceedings.

v) The work under the contract shall continue as directed by the Engineer-In-Charge, during the arbitration proceedings.

vi) Unless otherwise agreed, the venue of arbitration proceedings shall be at the venue given in the ‘Memorandum’ to the ‘Form of Tender’.

vii) The award of the Arbitrator shall be final, conclusive and binding on both the parties.

viii) Subject to the aforesaid, the provisions of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015 or any statutory modifications or re-enactment thereof and the Rules made there under and for the time being in force shall apply to the arbitration proceedings and Arbitrator shall publish his Award accordingly.
76.3 **JURISDICTION:**
The courts in Delhi/New Delhi alone will have jurisdiction to deal with matters arising from the contract, to the exclusion of all other courts.

50.0 **DEFECT LIABILITY PERIOD**
Clause no. 74.0 of GCC shall be read as for a period of 24 months from the date of taking over of the works in place of 12 months.

51.0 **GENERAL CONDITION OF “GRIHA” REQUIREMENT FOR ALIMCO PROJECT**
The ALIMCO intends to develop green complex & obtain “GRIHA” requirement for the proposed facilities included “GOLD” rating of “GRIHA” in the project. Bidder to familiarize the requirements and note that all requirements of above pertaining to construction for achieving the above targeted rating. No extra payment shall be made on this account.

52.0 **COMPLIANCE OF CONSTRUCTION & DEMOLITION WASTE MANAGEMENT RULES 2016.**
The contractor shall comply all the rules & regulation of Construction & Demolition Waste Management Rules 2016 as notified by the Government of India as applicable for the said work and subsequent amendment if any, in the said act notified by the Government time to time. Nothing shall be paid extra.

53.0 **FACILITIES TO BE PROVIDED AT SITE FOR LABOUR WELFARE**
All facilities to be provided him at site for fulfilling all GRIHA & statuary labour welfare schemes are included in contractor’s scope which shall include the following but not limited to the same.

- Separate provision / rooms for First Aid Centre & Reset room and for the safety officer, safety supervisors and other personnel to be engaged by the contractor for H.S.E aspects of the project.
- Erecting sufficient numbers of Urinals, WC’s, drinking water, water supply and sanitary arrangements to the supervisory personnel and workmen engaged by them.
- Canteen facility to workmen engaged by the contractor.
- Treatment of waste from contractor’s toilets to meet the requirements of “GRIHA”.
The contractor shall deploy an experienced & qualified person exclusively for implementation of “GRIHA” requirements for the entire contract period.

54.0 **Supply of Cement:** EPI may arrange supply of cement through Cement Corporation of India (CCI) subject to:

1. The supply rate at site are agreed between the Contractor and CCI.
2. The payment condition are agreed by the contractor and CCI.

3. No delay on account of delayed supply of cement will be acceptable as the contractor is free to procure outside cement in case of non-availability with CCI.

4. The contractor shall get cement tested from certified independent accredited agency and shall be solely responsible for quality.

..........
TENDER DOCUMENT

TENDER No. DLI/CON/752/569

FOR

Construction of Township (Type - I 12 nos., Type- II 10 nos. & Type- III 02 nos. Residential Qtrs.) in village, Hora Bangar, for ALIMCO Kanpur (UP).

VOLUME – II

TECHNICAL SPECIFICATIONS AND DRAWINGS
TECHNICAL SPECIFICATION

PARTICULAR SPECIFICATIONS FOR CIVIL WORK
1.0 All works will be executed in the most substantial and workman like manner both as regards materials and otherwise in every respect in strict accordance with DSR-2014/ Latest CPWD Specifications with up to date correction slips and as per the direction of Engineer of in charge. The decision of Engineer in charge shall be final and binding. All special activities shall be carried out by specialized agency only after approval of Engineer In-Charge.

2.0 EARTH WORK

2.1 Before commencing the earth work, the ground levels shall be taken at 5 to 15m interval or as shall be directed by the Engineer-in-charge. Where local mounds, pits or undulations are met with closer internal shall be adopted.

2.2 The ground levels shall be recorded in the level books and plotted on plan on suitable scale as per direction of Engineer-in-charge. The North direction and position of Bench Mark shall be shown on the plans. The ground levels for building and the sub-soil water level shall be determined with respect to the bench mark approved by the Engineer-in-charge before commencement of the work and these levels shall be recorded in the level book and also indicated on the ‘Plan’ showing ground levels. These plans shall be signed by the Contractor and the Engineer-in-charge before the earth work is started.

2.3 All laborers and material for setting out and making profile and taking ground levels shall be supplied by the contractor and nothing extra shall be payable on this account.

2.4 The Bidder shall co-operate and provide all possible assistance to the other agency / agencies executing other works. He shall adjust his execution program to accommodate such essential activities of construction.

2.5 Rate for earth work shall include the following operations:

a. Setting out works, profiles
b. Site clearance
c. Protection measures and putting up caution signs and lights.
d. Handling useful materials and Antiques.
e. Bailing out or pumping of rain water out of excavation.

3.0 CONCRETE / REINFORCED CEMENT CONCRETE WORK/ DESIGN MIX CONCRETE

3.1. Cement concrete work using nominal mix concrete shall be executed as per DSR/CPWD Specifications with up to date correction slips.

3.1(a) The item machine batched , machine mixed and machine vibrated design mix concrete used in the nomenclature of “ Sub head RCC Work” shall mean the concrete produced in automatic concrete batching and mixing plant and transported by transit mixers ( if necessary) , placed in position and vibrated by surface vibrator / needle vibrator / plate vibrator as the case may be to achieve required strength and durability.
3.2. All stone aggregate and stone ballast shall be of hard stone variety to be obtained from approved quarries or any other source to be got approved by the Engineer-in-charge.

3.3. Sand to be used for cement concrete RCC work shall not contain silt content by more than 8%.

3.4. Ordinary Portland Cement (OPC) not less 43 grade as per IS: 8112 or Portland Pozzolona Cement (PPC) as per IS: 1489-1991 shall be used for the entire work. However, necessary deduction towards difference of rates between OPC & PPC cement shall be account fore.

3.5. All shuttering shall either be of steel or marine ply. All scaffolding shall be of steel. The contractor will have to manufacture new shuttering so as to obtain exposed concrete surface of even and uniform shade wherever required. Shuttering already used on other work(s) will not be permitted to be used in this work for obtaining exposed concrete surface. The steel / marine ply centering, shuttering and steel scaffolding shall be as per DSR/CPWD specifications.

3.6. Keeping in view the flooring thickness as per nomenclature of the item, the structural drawings shall be reconciled with the architectural drawings to make appropriate adjustment in the level of shuttering for RCC slab so as to achieve the final floor finish level as per Architectural drawing.

**DESIGN MIX CONCRETE**

3.7. The contractor shall exercise “very good” quality control over site conditions for production of controlled concrete by using fresh cement and regular tests employing fully automatic cement batching plant for batching of all materials, grading of aggregate, determination of moisture contents and control of water cement ratio, frequent supervision and by conducting regular workability and strength tests and maintaining adequate field laboratory facilities to maintain the specified quality of concrete consistently.

3.7(a) The aggregate used for RCC work shall be 20mm nominal maximum size aggregate. The minimum cement content and the maximum water cement ratio for various grades of concrete shall be as given below:
<table>
<thead>
<tr>
<th>Grade Designation</th>
<th>Compressive strength on 15cm cubes min7 days (N/mm²)</th>
<th>Specified Characteristic compressive at 28days (N/m²)</th>
<th>Minimum cement content (kg per cubic metre)</th>
<th>Maximum water cement ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-25</td>
<td>AS per Design</td>
<td>25</td>
<td>330</td>
<td>0.50</td>
</tr>
<tr>
<td>M-30</td>
<td>AS per Design</td>
<td>30</td>
<td>340</td>
<td>0.45</td>
</tr>
<tr>
<td>M-35</td>
<td>AS per Design</td>
<td>35</td>
<td>350</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Note: Excess/Less cement content used as per design mix in respect of the above specified limit is payable / recoverable separately.

3.7(b) The concrete mix will be designed for minimum workability as per the table given below:

<table>
<thead>
<tr>
<th>Placing conditions</th>
<th>Degree of workability</th>
<th>Slump (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightly reinforced sections in slabs, beams, walls and columns</td>
<td>Low</td>
<td>25 –75</td>
</tr>
<tr>
<td>Heavily reinforced section in slabs beams walls and columns</td>
<td>Medium</td>
<td>50-100</td>
</tr>
<tr>
<td>Pumped concrete</td>
<td>Medium</td>
<td>75-100</td>
</tr>
</tbody>
</table>

3.8. The contractor shall engage one of the following approved laboratories, test houses for designing the concrete mix in accordance with the relevant I.S. Codes and to conduct laboratory tests to ensure the target mean strength and workability criteria for a given grade of concrete.
i. I.I.T./ NIT/any Government laboratory

If all the above laboratories express in writing their inability to carry out designing and testing of concrete mixes by a specified date, the contractor may be allowed to engage any other laboratory with prior approval of Engineer-in-charge.

3.9. The source and quality of all ingredients of a concrete mix shall be got approved from the Engineer-in-charge before designing the mixes and their testing and the same shall be maintained during the execution of the work as well.

3.10. Any change in source or characteristic of any ingredient used in the concrete mix during the work execution shall require revised mix design and laboratory testing as per direction of the Engineer-in-charge and no further concrete work shall be proceeded without approval of the revised design mix.

3.11. In the event of use of admixtures to achieve the required workability, the mix shall be designed and tested using the admixture in suitable proportion.

3.12. All cost and charges of designing the concrete mix and its testing by approved laboratory including the redesigning of the concrete mix, whenever required and directed by the Engineer-in-charge, shall be borne by the Contractor and nothing extra shall be payable over the quoted rates.

3.13. The designed mix proportions shall be checked for target mean compressive strength by means of trial batches.

3.14. The quantities of materials for each trial mix shall be sufficient for at least six specimens (cubes) and the concrete required for carrying out workability test.

3.15. The workability of trial mix No. 1 shall be measured and mix shall be carefully observed for freedom from segregation, bleeding and its finishing characteristics. The water content, if required, shall be adjusted corresponding to the required change in the workability.

3.16. With the modified water content, the mix proportions shall be recalculated by keeping with water cement ratio unchanged. The mix proportion, so modified, shall form the Trial Mix No. 2 and tested for the specified strength and workability.

3.17. In addition, trial mix No. 3 and 4 shall be designed by keeping water contents same as that determined for trial mix 2 but varying the water cement ratio by ± 10 percent of the specified value and tested for their design characteristics.

APPROVAL OF DESIGN MIX CONCRETE

3.18. Minimum three sets of separate preliminary tests shall be carried out for each trial batch of concrete mix. Each test shall comprise of six specimens and only one test-set of six specimens shall be made on any particular day.

3.19. Of the six specimens of each test-set, three specimens shall be tested at 7 days and remaining three at 28 days.
3.20. The Preliminary tests at 7 days are intended only to indicate the likely strength to be attained at 28 days while the design mix shall be approved only on the basis of test strength at 28 days.

3.21. The contractor shall submit the design mix report from the approved laboratory within 45 days of award of work for approval of Engineer-in-charge. No concreting work shall be executed until the mix design is approved.

3.22. The design mix shall be considered satisfactory and approved if at least three preliminary test-sets individually satisfy the following strength and workability criteria:

   a  The average strength of each test-set is not less than the specified target mean compressive strength.

   b  The strength of any specimen cube is not less than 0.85 times the target mean compressive strength.

   c  The concrete mix is of required degree of workability and acceptable concrete finish.

**PRODUCTION OF CONTROLLED CEMENT CONCRETE**

3.23 Automatic Batching Plant conforming to IS 4925-1968 and minimum 30 cum/ hour capacity shall be used for production of controlled concrete.

3.24 Automatic batcher shall be charged by devices which, when actuated by a single starter switch, will automatically start weighing operation of each material and stop automatically and interlocked when the designated weight of each material has been reached.

3.25 The batching system shall have rated capacity (in terms of concrete in a single batch) to match the maximum rated size of the mixer that could be adopted for use with the plant.

3.26 The mixers shall be free fall tilting type conforming to IS 1791-1968.

3.27 All measuring equipment shall be maintained in a clean and serviceable condition and their accuracy shall be checked at least once a month.

3.28 Only single sized good quality stone aggregate shall be brought to site of work from the approved source. The grading of the stone aggregate shall be controlled by blending the aggregate of different sizes in the required proportions at site of work.

3.29 The aggregate of different sizes shall be stock-piled separately at least a day before use. The grading of coarse and fine aggregates shall be checked as frequently as possible and as directed by the Engineer-in-charge to ensure that the specified grading and quality of aggregate is maintained.

3.30 It is important to maintain the water cement ratio constant at its specified or approved value by making adjustment for the moisture contents of both fine and coarse aggregates.
3.31 The moisture contents in the aggregate shall be determined as frequently as possible in keeping with the weather conditions as per the provisions of I.S 2386 (Part III) 1963.

3.32 All other operations involved in concrete work like laying, placing, compaction and curing etc. shall be done as per CPWD specifications 1996 Volume I to VI with up to date correction slips.

3.33 For RCC Work, the contractor may be permitted to use ready mixed concrete (RMC) procured from the approved suppliers of RMC instead of producing concrete at site. The specifications for RMC shall be same as for Design mix concrete produced at site. The prescribed tests for design mix concrete shall also be carried out for RMC in addition to getting the test report from the supplier. Nothing extra shall be paid for using RMC.

3.33(a) The contractor shall obtain prior approval of Engineer –in - Charge for using RMC, which shall be granted only in exceptional cases like failure of plant or other exigencies.

**SAMPLING AND STRENGTH OF WORK TEST OF CONCRETE**

3.34 Samples from fresh concrete shall be taken as per IS-1199-1959 and the test cubes shall be made, cured and tested in accordance with IS 516-1959.

3.35 Each test sample shall comprise of six test cubes (specimen), three of which shall be tested at 7 days and remaining for tests at 28 days.

3.36 A random sampling procedure shall be adopted to ensure that the sampling is spread over the entire period of concreting and cover all mixing units.

3.37 The concrete work shall be notionally divided into lots as under for the purpose of sampling conditions:

   a  Footings, rafts, etc.
   b  Columns and walls at all levels
   c  Beams at all levels
   d  Slabs at all levels

3.38 At least one test sample shall be taken for each lot of concrete work.

3.39 Each grade of concrete shall form different lot of testing.

3.40 The minimum frequency of sampling of concrete of each grade shall be as given below:
Alimco Township Village Hora Bangar, Kanpur (UP)

<table>
<thead>
<tr>
<th>Qty. of Concrete work (in Cum.)</th>
<th>Number of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>1</td>
</tr>
<tr>
<td>6-5</td>
<td>2</td>
</tr>
<tr>
<td>16-30</td>
<td>3</td>
</tr>
<tr>
<td>31-50</td>
<td>4</td>
</tr>
<tr>
<td>51 and above</td>
<td>4+ one sample for additional 50m$^3$ or part thereof.</td>
</tr>
</tbody>
</table>

The concrete work shall be assessed on day to day basis and samples shall be taken as specified.

**TEST STRENGTH OF A SAMPLE**

3.41 The test strength of the sample shall be taken as the average of the strength of its three specimens, the individual variation between the three specimens should not be more than ± 15 percent of the average test results of the sample.

3.42 If individual variation in strength of three specimens is more than ± 15 percent of average, the test results of the sample shall be invalid.

3.43 90% of the total work tests shall be done at the field laboratory established at the site of work and the remaining 10% work tests shall be got done from any Govt. laboratory or the laboratory approved by the Engineer in charge.

**MEASUREMENTS**

3.44 The measurements of work and the allowable tolerances shall be governed by provisions of CPWD specifications read with up to date correction slips.

3.45 The theoretical consumption of cement in designs mix concrete shall be worked out on the basis of proportions approved for Design mix subject to the permissible variations under clause 42 of the tender documents.

**RATE**

3.46 The rate shall include cost of all materials and labour involved in all operations described above including the cost of designing and testing of concrete mix in the approved laboratory including admixture but excluding the cost of centering, shuttering and reinforcement.

4.0 **WATER PROOFING TREATMENT**
4.1 GENERAL

4.1.1 The waterproofing treatment shall be carried out as per detailed specifications indicated for the same from the agency to be approved by the Engineer in Charge.

4.1.2 Two samples of the waterproofing materials / compound proposed to be used shall be submitted to the Engineer-in-charge along with test result from a testing laboratory of repute confirming its quality and performance and the constituents making it.

4.1.3 Total quantity of the waterproofing material / compound required shall be arranged only after obtaining the prior approval of the Engineer-in-charge in writing. Materials shall be kept under double lock and key and proper account of the waterproofing / material compound used in the work shall be maintained. It shall be ensured that the consumption of the material / compound is as per specified requirement.

Cement based integral waterproofing compound

Shall be of specified quality and also satisfy all the performance requirements indicated in IS Code 2645-1975. The compound shall be used @ 2% by weight of cement used (or as recommended by the manufacturer).

Any other waterproofing compound, if specified for use, shall satisfy the manufacturer’s specifications.

4.2 MEASUREMENT

4.2.1 The measurement shall be taken along the finished surface of treatment including the rounded and tapered portions at junctions. Length and breadth shall be measured correct to one centimeter and area shall be worked out nearest to two decimals.

4.3 RATE

4.3.1 The rate shall be inclusive for all operations described in the nomenclature and the specifications applicable to the item, including any incidental expenditure. Nothing extra shall be payable on any account whatsoever.

5.0 BRICK WORK

5.1 The brick work shall be carried out with good quality well burnt bricks of specified designation, free from ash, dust or mud etc.

5.2 Only well wet bricks shall be used for brick work in cement mortar.

5.3 The cement mortar of specified mix shall be uniformly mixed to the required consistency in the Mixer Machine with hopper attached only and measuring boxes shall be used for proper proportion of mortar mix.
5.4 All the joints of brick work both horizontal and vertical shall be filled in completely with cement mortar. The joints shall be of uniform thickness of not more than one cm.

6.0 Powder coated Aluminum Work for Doors and windows:

6.1 The Contractor shall engage specialized agency for doing the aluminum work and the agency shall be got approved from the Engineer –in -Charge.

6.2 The materials conforming to specifications as mentioned in the nomenclature of item shall only be used for fabrication of Aluminum doors and windows.

6.3 All Aluminum work shall be free from defects impairing strength, durability and appearance. The makes of aluminum sections shall be as given in “List of approved Makes for Civil Work”

6.4 The contractor shall submit shop drawings and samples of each type of doors and windows to the Engineer-in-charge for approval. The shop drawings shall show full size sections of doors and windows. Shop drawings shall be based on actual dimensions available on site, which should not vary from those on drawings by 1.5mm.

6.5 The glazed aluminum windows shall be made completely water proof to the satisfaction of the engineer-in-charge. Silicon/ Polysulphide sealants etc; shall be provided wherever required to make the window water proof.

6.6 All joints shall be accurately fabricated. The finished surface shall be free from visible defects.

6.7 The Powder coating shall be of approved colour and conform to IS code

6.8 Doors, windows or fixed glazing, frames shall be fixed to concrete /brick work / base frame with approved metal fasteners. Method of fixing shall be approved by the Engineer-in-charge before mass fabrication.

6.9 A thick layer of the clear transparent lacquer based Methacrylates or Cellulose Butyrate shall be applied on the powder coated surfaces before they are brought to site. The same shall be removed on completion of erection.

6.10 All screws shall be stainless steel screws.

6.11 The corners of the frame shall be fabricated true to right angle. Both the fixed and openable frames shall be fabricated out of sections, which have been cut to length, mitred and jointed mechanically. All members shall be accurately machines milled and fitted to form hair line joints. The joining accessories such as cleats, brackets, etc shall be such material so as not to cause any bimetallic corrosive action.

All frame members shall be in plumb and level and jointed in such a way that the expansion and contraction shall not cause distortion or leakage. The contractor shall be responsible for their satisfactory performance/ operation after fixing is complete.
6.12 Clear glass: The glass shall be float glass of Brand Modi or equivalent. Clear glass used in glazing of open able / fixed doors windows and ventilators shall provide clear, completely undistorted vision and reflection. It shall be free from any bubbles, waves or blemishes. Glass used shall be of required size as per drawings.

6.13 Tinted Glass: Tinted glass shall have same quality and specifications as indicated above for clear glass. It shall however be transparent glass tinted to Bronze/Blue/Green/Smoke grey shade as required and would be expected to absorb a greater proportion of sun’s radiant heat and reduce transmission than clear glass.

6.14 Rate: The rate shall include the cost of all materials as mentioned above and in the nomenclature of item, labour and T&P required for proper completion of the work including the sealant but excluding the clear/ tinted glass which shall be measured and paid separately under relevant item. For payment purposes, the weight of aluminum sections finished to size as provided in doors and windows excluding the cleats shall only be measured.

7.0 Flooring

7.1 Only machine cut Kota stone, sand stone marble, granite slabs shall be used for flooring and veneering work.

7.2 Proper gradient shall be given to flooring for toilets, verandah, kitchen, court, yard etc and shall be determined by providing required gradient in the lean concrete/ sub-grade surface.

7.3 The bed mortar on concrete shall be fully compacted, particularly at the junctions of panels, during laying of flooring so that the finished floor does not give hollow sound.

8.0 Roofing

8.1 The roofing shall be executed as specified in the nomenclature and detailed specifications for the item.

8.2 The work of fixing rainwater pipes, grouting around mouth of rain water pipes and making khurra shall be done before starting the items of roofing. The roofing shall overlap the khurra surface by about 100mm.
8.3 Plastering of parapet wall shall only be done after providing required cement concrete gola at the junctions with horizontal surface of roofing. In case of RCC parapet wall 75 x 75mm cement concrete gola shall be provided after making groove at at least 20mm in depth. Cement slurry shall be applied over the groove before laying cement concrete gola. For parapets walls in brick work, the cement concrete gola shall be provided as per operations described in DSR/CPWD Specifications with up to date corrections slips.

9.0 FINISHING

9.1 CEMENT PLASTER

The cement plaster shall be 12 mm, 15 mm or 20 mm thick as specified in the item.

9.1.1 Scaffolding

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

For all other work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

9.1.2 Preparation of Surface

The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

9.1.3 Mortar

The mortar of the specified mix using the type of sand described in the item shall be used. It
shall be as specified in Subhead 3.0. For external work and under coat work, the fine aggregate shall conform to grading IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

9.1.4 Application of Plaster

9.1.4.1 Ceiling plaster shall be completed before commencement of wall plaster.

9.1.4.2 Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 15 × 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and sideways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive toweling or over working the float shall be avoided.

9.1.4.3 All corners, arrises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, provision of grooves at junctions etc. where required shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required.

9.1.4.4 When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scraped cleaned and wetted with cement slurry before plaster is applied to the adjacent areas, to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of wall and not nearer than 15 cm to any corners or arrises. It shall not be closed on the body of the features such as plasters, bands and cornices, nor at the corners of arrises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakages. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar. No portion of the surface shall be left out initially to be patched up later on. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

9.1.5 Thickness

Where the thickness required as per description of the item is 20 mm the average thickness of the plaster shall not be less than 20 mm whether the wall treated is of brick or stone. In the case of brick work, the minimum thickness over any portion of the surface shall be not less than 15 mm while in case of stone work the minimum thickness over the bushings shall be not less than 12 mm.

9.1.6 Curing
Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered.

The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor’s expense by such means as the Engineering-Charge may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

9.1.7 Finish

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

9.1.8 Precaution

Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer-in-Charge.

(i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green.

(ii) To prevent surface cracks appearing between junctions of column/beam and walls, 150 mm wide chicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in one go. For providing and fixing chicken wire mesh with U nails payment shall be made separately.

9.1.9 Measurements

9.1.9.1 Length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal.

9.1.9.2 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in brick work.

9.1.9.3 The measurement of wall plaster shall be taken between the walls or partitions (the dimensions before the plaster shall be taken) for the length and from the top of the floor or skirting to the ceiling for the height. Depth of coves or cornices if any shall be deducted.

In measuring jambs, sills and soffits, deduction shall not be made for the area in contact with the frame of doors, windows etc.

9.1.10 Rate
Alimco Township Village Hora Bangar, Kanpur (UP)

The rate shall include the cost of all labour and materials involved in all the operations described above.

9.2 6 MM CEMENT PLASTER ON CEMENT CONCRETE AND REINFORCED CEMENT CONCRETE WORK

9.2.1 Scaffolding

Stage scaffolding shall be provided for the work. This shall be independent of the walls.

9.2.2 Preparation of Surface

Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition concrete surfaces to be plastered shall be pock marked with a pointed tool, at spacings of not more than 5 cm. Centres, the pock being made not less than 3 mm deep. This is to ensure a proper key for the plaster. The mortar shall be washed off and surface, cleaned off all oil, grease etc. and well wetted before the plaster is applied.

9.2.3 Mortars

Mortar of the 1:3 (1 Cement: 3 sand) mix using the types of sand described in the item shall be used.

9.2.4 Application

To ensure even thickness and a true surface, gauges of plaster 15 x 15 cm. shall be first applied at not more than 1.5 m intervals in both directions to serve as guides for the plastering. Surface of these gauged areas shall be truly in the plane of the finished plaster surface. The plaster shall be then applied in a uniform surface to a thickness slightly more than the specified thickness and shall then be brought to true and even surface by working a wooden straight edge reaching across the gauges. Finally the surface shall be finished true with a trowel or with wooden float to give a smooth or sandy granular texture as required. Excess troweling or over working of the floats shall be avoided. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar. Plastering of ceiling shall not be commenced until the slab above has been finished and centring has been removed. In the case of ceiling of roof slabs, plaster shall not be commenced until the terrace work has been completed. These precautions are necessary in order that the ceiling plaster is not disturbed by the vibrations set up in the above operations.

9.2.5 Finish

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

9.2.6 Thickness

The average thickness of plaster shall not be less than 6 mm. The minimum thickness over any portion of the surface shall not be less than 5 mm.
9.2.7 Measurements

9.2.7.1 Length and breadth shall be measured correct a cm. and its area shall be calculated in sqm. correct to two places of decimal. Dimensions before plastering shall be taken.

9.2.8 Rate

The rate shall include the cost of all labour and materials involved in all the operations described above.

9.3 OIL EMULSION (OIL BOUND) WASHABLE DISTEMPERING

9.3.1 Materials

Oil emulsion (Oil Bound) washable distemper (IS 428) of approved brand and manufacture shall be used. The primer where used as on new work shall be cement primer or distemper primer as described in the item. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for day’s work shall be prepared. The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight’s work, and the same shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty tins shall not be removed from the site of work, till this item of work has been completed and passed by the Engineer-in-Charge.

9.3.2 Preparation of the Surface

9.3.2.1 For new work the surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

9.3.2.2 In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt etc. Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

9.3.3 Application

9.3.3.1 Priming Coat : The priming coat shall be with distemper primer or cement primer, as Required in the description of the item. Oil bound distemper is not recommended to be applied, within six months of the completion of wall plaster. However, newly plastered surfaces if required to be distempered before a period of six months shall be given a coat of alkali resistant priming Paint conforming to IS 109 and allowed to dry for atleast 48 hours before distempering is commenced.
9.3.3.2 Distemper Coat: For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sandpapered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitutes one coat. The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade. A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of the preceding coat.

15 cm double bristled distemper brushes shall be used. After each day's work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

9.3.4 Measurement:
Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals.

9.3.5 Rate
The rate shall include the cost of all labour and materials involved in all the above operations (including priming coat) described above.

9.4 EXTERIOR PAINTING ON WALL

9.4.1 Material
The paint shall be (Textured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint) of approved brand and manufacture.

This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight’s work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

9.4.2 Preparation of Surface
For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer in charge after inspection before painting is commenced.

9.4.3 Application
Base coat of water proofing cement paint
9.4.3.1 Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer’s instructions & directions of the Engineer-in-charge shall be followed meticulously.

The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust.

9.4.3.2 Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

9.4.4 Measurement: Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals.

9.4.5 Rate

The rate shall include the cost of all labour and materials involved in all the above operations (including priming coat) described above.

9.5 PAINTING SYNTHETIC ENAMEL PAINT OVER STEEL WORK

9.5.0 Synthetic Enamel

Paint, suitable for painting over Steel work, of approved brand and manufacture and of the required shade shall be used. New or weathered steel work shall be painted with a priming coat of one coat of red oxide zinc chromate Paint. Primer shall be applied before fixing sheets in place. Two or more coat of paint has to be applied as per requirement.

9.5.1 Preparation of Surface

9.5.1.1 Painting New Surface: The painting of new steel work shall not usually be done till they have weathered for about a year. When new surface are to be painted before they have weathered they shall be treated with a mordant solution prepared by mixing 38 gm of copper acetate in a litre of soft water or 13 gm hydrochloric acid in a solution of 13 gm each of copper chloride, copper nitrate and ammonium chloride dissolved in a litre of soft water. This quantity of solution is sufficient for about 235 sqm. to 280 sqm of area and is applied for ensuring proper adhesion of Paint.

Before painting on new or weathered steel surface, rust patches shall be completely cleaned with coarse emery paper and brush. All grease marks shall also be removed and the surface washed and dried and rusted surface shall be touched with synthetic enamel paint of approved brand, manufacturer and shade.

9.5.2 Measurement:

Measurement of surface shall be taken in sqm.
9.5.3 Rate

Rates shall include cost of all labour and materials involved in all the operations described above.

9.6 Plaster of Paris

The plaster of Paris shall be of the calcium-sulphate semi-hydrate variety. Its fineness shall be such that when sieved through a sieve of IS sieve designation 3.35 mm for 5 minutes the residue left on it after drying shall be not more than 1% by weight. It shall not be too quick setting. Initial setting time shall not be less than 13 minutes. The average compressive strength of material determined by testing 5 cm cubes after removal from moulds, after 24 hours and drying in an oven at 40 degree C till weight of the cubes is constant, shall not be less than 84 kg per square metre.

9.6.1 Applications

The material will be mixed with water to a workable consistency. Plaster of Paris shall be applied to the underside of the laths over the rabbit wire mesh in suitable sized panels and finished to a smooth surface by steel trowels. The plaster shall be applied in such a manner that it fully fills the gaps between the laths and the thickness over the laths is as specified in the description of the item. The joints shall be finished flush to make the ceiling in one piece. The finished surface shall be smooth and true to plane, slopes or curves as required. The thickness of POP layer should be maintained 10mm. The design should be according to drawing and should be done by expertise agency.

9.6.2 Measurements

9.6.2.1 Length and breadth of superficial area of the finished work shall be measured correct to a cm. Area shall be calculated in square metre correct to two places of decimal. No deduction will be made to openings of areas upto 40 square decimeter nor shall extra payment be made either for any extra material or labour involved in forming such openings.

9.6.3 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including all scaffolding, staging etc.

10 RCC WORK

10.1 To ensure proper cover only factory made approved cover blocks will be used to avoid displacement of bars in any direction.

10.2 The Steel bars of different diameters should be stored about 30 to 45 cm above ground level to avoid corrosion of steel. No extra payment shall be made on this account.

11 FLOORING:
Alimco Township Village Hora Bangar, Kanpur (UP)

The rate of items of flooring is inclusive of providing sunk flooring in bathrooms, kitchen etc. and nothing extra on this account is admissible. The flooring is to be laid in pattern of various combinations as per architectural drawings. The flooring in treads and risers of stair case is to be laid in single piece. Nothing extra shall be paid on these accounts. The measurement shall be made for finished work of flooring.

Misc

1. Structural glazing

General

|   | Framing system | Aluminum anodized extruded sections manufactured by reputed manufacturers. For all types of members like brackets, mullions, transom etc. |
|---|----------------|---------------------------------------------------------------------------------------------------------------------------------
| 2 | Sealant        | As specified in the item of silicon sealant                                                                                                                                 |
| 3 | Insulation     | 50mm thick glass wool of minimum density 48kg/cum sandwiched with black polythene sheet 100 micron on one side and aluminum foil of 100 Micro on the other side or as specified by manufacturer at spandrel area. The surface after fixing insulation shall be plain without any distortion |
| 4 | Heat reflective Toughened Glass | (a) St. Gobain – Reflect solar as specified  
(b) Glaverbel/ Glavermass – Super Silver  
(c) Visteon Ford |

Brown or Grey Color or any shade approved by the Client/ Engineer-in-Charge/ Architect

SCOPE OF WORK

Preliminary Requirements

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

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

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

(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
(d) All fire protection associated with the system
(e) All copings and closure and metal cladding to complete the system
(f) All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system
(g) Isolation of dissimilar metals and moving parts.
(h) Anticorrosive treatment on all metals used in the system
(i) Polyester powder coating aluminum sections.
(j) The contractor shall also be responsible for providing the following:
(k) Mock-ups, samples and test units.
(l) Performance testing of the curtain wall framing and glazing assembly.
(m) Co-ordination with the work of other trades
(n) Insulation with glass wool 48 kg/cum at spandrels area.
(o) Protection.
(p) All final exterior and interior cleaning and finishing of the curtain wall system.
(q) As built record drawings and photographs.
(r) Guarantees and warranties.
(s) All hoisting, scaffolding, staging and temporary services.
(t) Conceptualizing and design of a suitable maintenance system for curtain glazing.
(u) The water tightness and structural stability of the whole curtain wall system are prime responsibility of the contractor. Any defect or leakage found within the guarantee period shall be sealed and made good at all the risk and cost of the contractor.
(v) The curtain wall system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects, specific details should be designed to accommodate thermal and building movements.

Quality Consideration and Other Activities

(i) The contractor while submitting the detailed design calculations should submit the following information on the quality of materials to be used and other aspects as detailed below:
(1) Metal quality, finishes and thickness
(2) Glass quality, coating and thickness and proposed manufacturer’s brand names
(3) Aluminum extruded sections including mullions and transoms together with structural calculations and proposed manufacturer’s brand name and also the name of agency proposed for fabrication work
(4) Arrangement and jointing of components.
(5) Field connections especially mullion to mullion and transom to mullion.
(6) Fixing and anchorage system of typical wall unit together with structural calculations.
(7) Drainage system and provision in respect of water leakage in the curtain wall system
(8) Provisions for thermal movements.
(9) Sealant and sealing methods.
(10) Glazing method.
(11) Wind load and seismic load and any other specific load considered in the design
Alimco Township Village Hora Bangar, Kanpur (UP)

(12) Design concept over lightening protection link-up system of the curtain wall for connection and incorporation into the lightening conductor system of the building (Lightening conductor system of the building to be done by any other agency)

(13) The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case these tolerances exceed those specified in the specification.

**Tolerances**

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

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

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

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

**Test of Wind Pressure**

(i) 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.

(ii) The static wind pressure shall be applied up to 1.5 kpa at maximum wind pressure.

(iii) The variation of dynamic pressure shall be of any approximate sine curve line.

(iv) Deflection on each observational points of the test unit shall be observed and recorded under static pressure as described above

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

(vi) The deflection on the main structural parts in this condition shall not exceed:

(vii) $1/175$ of the span between supports or 20mm, whichever is less for vertical elements.

(viii) $1/250$ of the span between supports for horizontal elements.

(ix) The extent of recovery of deformation, 15 minutes after the removal of the test load, is to be at least 95%.

**Test of Lateral Deflection per Floor Height**

(i) Lateral deflection per floor height shall occur on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

(ii) The deflection of every $\pm 2.5$mm shall be increased up to $\pm 13$mm on the test unit (static deflection test)

(iii) The dynamic deflection shall be applied up to $\pm 13$mm.

(iv) The variation of dynamic deflection shall be of an approximate sine curve line, on period of 3 seconds.
(v) The dimensions of the deflection on each observational point of the test unit shall be measured under the condition as described above and the dame shall be observed.
(vi) Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall except the damage to sealant at maximum deflection.

**Water Tightness Test**

(i) Water shall be sprinkled to the 'Test Unit' under wind pressure.
(ii) Pressure shall not be applied to the test unit
(iii) The volume of the sprinkling water in one minute shall be 5 litres per sqm minimum (01.gal/sq.ft.)
(i) All water leakage and drainage system at the joint and the open able sash of the curtain wall system shall be observed from the outside of the chamber.
(ii) Hold the test two times, in sequence as described below, conforming to the above mentioned conditions.
(iii) Install the test unit.
(iv) Hold first water tightness test
(v) Hold test of wind pressure as described above
(vi) Hold second water tightness test.
(vii) Lateral deflection test
(viii) Water leakage shall not be observed inside at all parts of the test unit during first water tightness test.

**Mode of Measurement**

the breadth and the height of the finished work including the open able windows shall be measured in meters and centimeter and the net quantity for payment shall be calculated in sqm up to two place of decimal, the area to be considered for measurement shall be the net area of the exterior face of the curtain wall as fixed including the open able windows if any as part of the curtain wall.

**Rate**

The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, mock-up test units, fabrication, erection, finishing, scaffolding, undertaking performance guarantee. No other claims of any kind pertaining to this work shall be entertained.

**STONE INSTALLATION**

Proceed with the installation of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges. Set stone with joints uniform in appearance and stone edges and faces aligned tolerances indicated. Clean surfaces that are dirty or stained. Scrub with fiber.
Alimco Township Village Hora Bangar, Kanpur (UP)

brushes, and then rinse with clear water. Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings.

Cleaning

After installation and pointing or caulking are completed, the contractor shall carefully clean the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident defacements. Stainless steel wire brushes or wool may be used, but the use of other wirebrushes or of acid or other solutions which may cause discoloration is expressly prohibited.

Fabricator should be contacted before cleaners other than detergents are used.

Protection of Finished Work

After the granite work is installed, the granite shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided wherever required, but no lumber which may stain or deface the granite shall be used. All nails used shall be non-corrosive. All granite work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

Defective Work

Any area or piece of granite found defective it shall be removed, and to be patched or redressed for use. Nothing extra on this account will be entertained.

Related sections

All work related to this specification section should be coordinated with the works described in other specification sections, including:

Mortar
Joints
Pointing
Curing

Mode of Measurement

The finished work shall be measured correct to a centimeter in respect of length and breadth nearest to two places of decimal. The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, fabrication, erection, finishing, scaffolding, etc. No other claims of any kind pertaining to this work shall be entertained.

Rate

The rate shall include the cost of materials and labor required for all the operations described above.
11. STEEL SUPPLIED BY THE CONTRACTOR

a) The Contractor shall furnish to the Engineer all mill orders covering the material ordered by him for this project and also the test reports received from the Mills for his approval and information. It is not intended that all the steel materials to be supplied by the Contractor for the work shall be specially purchased from the rolling mills. The Contractor’s stock material may be used, provided the mill test reports identified with the materials, satisfactorily demonstrate the specified grade and quality. The Engineer shall have the right to test random samples to prove authenticity of the test certificates produced by the Contractor, at the Contractor’s cost.

b) All steel materials supplied by the Contractor shall be in a sound condition, of recent manufacture, free from defects, loose mill scale, slag intrusions, laminations, pitting, flaky rust, etc. and be of full weight and thickness specified.

c) Wherever the Contractor, in order to accommodate his other materials in stock, desires to substitute structural steels or plates for the sizes shown on drawings, such substitutions shall be made only after authorization in writing by the Engineer.

d) The Engineer may direct that substitution be made, when he considers such substitutions is necessary.

12. FABRICATION

a) All fabrication work shall be done in accordance with IS: 800, read in conjunction with relevant codes mentioned therein.

b) Fabrication shall be done in workshops approved by Engineer, unless specifically permitted by Engineer that fabrication can be done at site. Under such circumstances work shall be done on a specially designed and constructed platform. Location, size, specification and construction of such a platform shall have prior approval of Engineer. Loads associated with such platforms shall be provided to Engineer.

c) Mild steel rolled sections and plates shall be cut by shearing/machining and grinding the surfaces to true sizes and shapes. Gas cutting of mild steel may be permitted by the Engineer, provided that every cut face and edge is smoothened by grinding operation. Prior approval of Engineer must be obtained for using gas cutting techniques either by mechanized gas cutters or manually operated gas cutters. While, using gas-cutting methods, proper allowance must be made for grinding to bring the cut piece to exact required dimensions.

d) Extensive use of templates shall be made in doing fabrication work. Templates shall be clean and should have true surfaces prepared for every successive use. Reinforcements for the structural steel members if required shall be included. In case actual members are used as templates for similar pieces, it will be at the discretion of the Engineer to decide whether such pieces are fit to be
incorporated in the finished structure. Jigs and manipulators shall be used, where practicable, and shall be designed to facilitate welding and to ensure that all welds are easily accessible to the operators.

e) All material shall be straight and free from twist and bends unless required to be curvilinear in from. If necessary the material shall be straightened and / or flattened / straightened by pressure. Heating of rolled sections and plates for purpose of straightening shall not be permitted.

f) Curvilinear members shall be formed by bending with the help of pneumatic press. Final shaping, to a very limited extent, however, may be done by local heat application. This shall be done only on receiving approval from the Engineer.

13. Holing

All holes shall be made at right angles to the surface of the member. Holes shall be clean cut without any torn or jagged edges. Holes shall be done by drilling. Punching shall not be resorted to, unless previously approved by the Engineer. In any case, punching of holes in materials having a thickness in excess of the connector diameter, or, for materials thicker than 16 mm, the hole shall be punched 3 mm less in diameter than the required size and then reamed to the full size. Holes shall not be formed or enlarged by burning or gas cutting under any circumstances.

14. WELDING

14.1 General

a) In general only Automatic submerged arc welding will be used for fabrication. Subject to approval of Engineer, Metal inert gas welding may be done for short length where access to the location of the weld does not permit submerged arc welding. The welding and the welded work shall conform to IS: 816, unless otherwise specified. As much work as possible shall be welded in shops and the layout and sequence of operations shall be so arranged as to eliminate distortion and shrinkage stresses. Unless otherwise specified all weld shall be for full contact for all sides.

b) Electrodes for shielded-arc manual welds shall comply with the requirements of IS:814 and shall be amenable to radiographic tests and shall be of approved make. The electrodes for manual arc welding shall be suitable for use in the position and type of work, as laid down in the above specifications and as recommended by the manufacturers. Electrodes classification group 1 or 2 as given in IS: 814 shall be used for welding steel conforming to IS: 2062. Electrodes shall conform to IS-1442 for steel conforming to IS: 8500. Joints in materials above 20 mm thick, and, all important connections shall be made with low hydrogen electrodes Electrode flux covering shall be sound and unbroken. Broken or damaged coating shall cause the electrodes to be discarded. Covered electrodes for manual arc-welding shall be properly stored in an oven prior to use in a manner recommended by the Manufacturer and only an hour’s quota shall be issued to each welder from the oven.

c) Electrodes larger than 5 mm diameter shall not be used for root-runs in buttweld. Welding plant and accessories shall have capacity adequate for the welding procedure laid down and shall satisfy appropriate standards and be of approved make and quality, the Contractor shall maintain all
welding plant in good working order. All the electrical plant in connection with the welding operation shall be properly and adequately earthed and adequate means of measuring the current shall be provided. All welds shall be made only by welders and welding operators who have been properly trained and previously qualified by tests to perform the type of work required as prescribed in the relevant applicable standards. All welds shall be free from defects like blow holes, slag inclusions, lack of penetration, undercutting, cracks etc. All welds shall be cleaned of slag or flux and show uniform sections, smoothness of weld metal, feather edges without overlap and freedom from porosity.

d) Fusion faces and surfaces adjacent to the joint for a distance of at least 50 mm on either side shall be absolutely free from grease, paint, loose scales, moisture or any other substance which might interfere with welding or adversely affect the quality of the weld. Joint surfaces shall be smooth, uniform and free from fins, tears, laminations etc. Preparation of fusion faces shall be done in accordance with the approved fabrication drawings by shearing, chipping, machining or machine flame cutting except that shearing shall not be used for thickness over 8 mm.

e) In the fabrication of cover-plated beams and built up members all shop splices in each component part shall be made before such component part is welded to other parts of the member. Wherever weld reinforcement interferes with proper fit-up between components to be assembled for welding, these welds shall be ground flush prior to assembly.

f) Members to be joined by fillet welding shall be brought and held as close together as possible and in no event shall be separated by more than 3 mm. If the separation is 1.5 mm or greater, the fillet weld size shall be increased by the amount of separation. This shall only apply in the case of continuous welds. The fit-up of joints at contact surfaces which are not completely sealed by welds shall be close enough to exclude water after painting.

g) The separation between fraying surfaces of lap joints and butt joints with backing plate shall not exceed 1.5 mm. Abutting parts to be butt welded shall be carefully aligned and the correct root gap maintained throughout the welding operation. Misalignments greater than 25 percent of the thickness of the thinner plate or 3 mm whichever is smaller shall be corrected and in making the correction the parts shall not be drawn into a slope sharper than 2 degrees (1 in 27.5). 

h) Welding procedures recommended by appropriate welding standards and known to provide satisfactory welds shall be followed. A welding procedure shall be prepared by the Contractor and submitted to the Engineer for approval before start of welding.

i) Approval of the welding procedure by the Engineer shall not relieve the Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

j) Voltage and current (and polarity if direct current is used) shall be set according to the recommendations of the Manufacturer of the electrode being used, and suitable to thickness of material, joint form etc. The work shall be positioned for flat welding wherever practicable and overhead weld shall be avoided.
k) No welding shall be done when the surface of the members is wet, nor during periods of high wind unless the welding operator and the work are properly protected. In joints connected by fillet welds, the minimum sizes of single run fillet welds or first runs and minimum full sizes of fillet welds shall conform to the requirements of IS: 816 and IS: 823. Fillet welds larger than 8 mm shall be made with two or more passes.

l) All ‘full penetration butt welds’ made by manual arc-welding, except when produced with the aid of backing material or welded in flat position, from both sides in square-edge material, not over 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross section.

m) Butt welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where abutting parts are 20 mm or more in thickness, run-on and run-off plates with similar edge preparation end having a width not less than the thickness of the thicker part joined shall be used. These extension pieces shall be removed upon completion of the weld and the ends of the weld made smooth and flush with the abutting parts. Where the abutting parts are thinner than 20 mm the extension pieces may be omitted but the ends of the butt welds shall then be chipped or gouged out to sound metal and side welded to fill up the ends to the required reinforcement.

n) Each layer of a multiple layer weld except root and surface runs may be moderately peeled with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from over-peeling.

o) Before commencing fabrication of a member or structure in which welding is likely to result in distortion and/or locked up stresses, a complete program of fabrication, assembly and welding shall be made and submitted to the Engineer for his approval. Such a programmed shall, include, besides other appropriate details, full particulars in regard to the following:

i) Proposed pre-bending of components such as flanges and presetting of joints to offset expected distortion.

ii) Make up of sub-assemblies proposed to be welded before incorporation in final assembly.

iii) Proposed joint forms, classification of wire and flux or covered electrodes, welding process including fitting and welding sequence with directions in which freedom of movement is to be allowed.

iv) Proposed number, spacing and type of strong details of jigs and fixtures for maintaining proper fit up and alignment during welding.

v) Any other special features like assembling similar members back to back or stress relief.

14.2 INSPECTION OF WELDS
a) All welds shall be inspected for flaws by any of the methods described in these specifications, and as per IS: 822. The choice of the method to be adopted shall be determined by the Engineer.

b) The Contractor shall arrange for all tests as called for in the schedule of quantities, at his own cost.

c) In case the tests uncover defective work, such tests shall be at the Contractor’s cost and the Contractor shall correct such defects at his own cost, and prove the soundness of rectified work.

d) The correction of defective welds shall be carried out as directed by the Engineer without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means as prescribed by the Engineer shall be used to ensure that the whole of the crack and material up to 25 mm beyond each end of the crack has been removed. Cost of all such tests and operations incidental to correction shall be to the Contractor’s account.

15. FABRICATION TOLERANCES

Unless otherwise shown on drawings, the fabrication tolerances shall generally be as detailed hereunder.

15.1 Straightness

The dimensional and weight tolerance for rolled shapes shall be in accordance with IS: 1852 for indigenous steel and equivalent applicable codes for imported steel. The acceptable limits for straightness (sweep and camber) for rolled or fabricated members shall be: Struts and columns: L/1000 or 15 mm whichever is smaller for all other members not primarily in compression such as purling, beams, bracings & web members of trusses and latticed girders: L/500 or 15 mm whichever is smaller. Where L is the length of finished member, or such lesser length as the Engineer may specify.

15.2 Twists

a) A limit for twist (prior to erection) in: Box girders and heavy columns: L/1500 Other members: L/1000

b) The twist of the member between any two sections shall be measured with the web vertical at one of the sections.

15.3 Camber

Tolerance in specified camber of structural members shall be ±3 mm.

15.4 Length

Tolerance in specified length shall be as follows:

Type of Member Tolerance

A column finished for contact bearing: +1 mm
Other members (e.g. beams) under 10 m: + 0 and - 3 mm

Other members (e.g. beams) 10 m long and over: + 0 and - 5 mm

**15.5 Square-Ness at End of Members**

a) Beam to beam and beam to column connections where the abutting parts are to be joined by butt welds, permissible deviation from the square-ness of the end is: Beams up to 600 mm in depth: 1.5 mm Beams over 600 mm in depth: 1.5 mm every 600 mm depth Up to a max of 3 mm

b) Where abutting parts are to be joined by bolting through cleats or end plates, the connections require closer tolerance. Permissible deviation from square-ness of the end is –

Beams up to 600 mm in depth: 1 mm

Over 600 mm in depth: max of 1.5 mm.

**15.6 Butt Joints**

For full bearing, two abutting ends of columns shall first be aligned to within 1 in 1000 of their combined length and then the following conditions shall be met:

a) Over at least 80% of the bearing surface the clearance between the surfaces does not exceed 0.1 mm.

b) Over the remainder of the surfaces the clearance between the surfaces does not exceed 0.3 mm. Where web stiffeners are designed for full bearing on either the top flange or bottom flange or both, at least half the stiffener shall be in positive contact with the flange. The remainder of the contact face could have a max. gap of 0.25 mm.

**15.7 Depth of Member**

Acceptable deviation from the specified overall depth is:

For depths of 900 mm and under: + / - 3 mm

For depths over 900 mm and under 1800 mm: + / - 5 mm

For Depths of 1800 mm and over: + 8 mm; - 5 mm.

**15.8 Web Plates**

Acceptable deviation from flatness in girder webs in the length between the stiffeners or in a length equal to the girder depth shall be 1/150th of the total web depth.

**15.9 Flange Plates**

a) Limit for combined warp-age and tilt on the flanges of a built up member is 1/200 of the total width of flange or 1.5 mm whichever is smaller measured with respect to center-line of flange.
b) Lateral deviation between center-line of web plate and center-line of flange plate at contact surfaces, in the case of built up sections shall not exceed 3 mm.

16. INSPECTION

16.1 The Contractor shall give due notice to the Engineer in advance of the materials or workmanship getting ready for inspection.

a) All rejected material shall be promptly removed from the shop and replaced with new material for the Engineer’s approval / inspection. The fact that certain material has been accepted at the Contractor’s shop shall not invalidate final rejection at site by the Engineer, if it fails to be in proper condition or has fabrication in-accuracies which prevent proper assembly. No materials shall be painted or dispatched to site without inspection and approval by the Engineer unless, such inspection is waived in writing by the Engineer.

b) Shop inspection by the Engineer or his authorized representative, or, submission of test certificates and acceptance thereof by the Engineer, shall not relieve the Contractor from the responsibility of furnishing material conforming to the requirements of these specifications. Nor shall it invalidate any claim, which the Engineer may make because of defective or unsatisfactory material and/or workmanship.

c) The Contractor shall provide all the testing and inspection services and facilities for shop work except where otherwise specified. For fabrication work carried out in the field, the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the Engineer.
DETAILED TECHNICAL SPECIFICATION – ELECTRICAL WORKS
## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Clause No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>Wiring</td>
</tr>
<tr>
<td>B)</td>
<td>Sub-Main Wiring</td>
</tr>
<tr>
<td>C)</td>
<td>Distribution Boards</td>
</tr>
<tr>
<td>D)</td>
<td>Telephone Wiring System</td>
</tr>
<tr>
<td>E)</td>
<td>Cabling for MATV System</td>
</tr>
<tr>
<td>F)</td>
<td>External Lighting</td>
</tr>
<tr>
<td>G)</td>
<td>Medium Voltage Cables</td>
</tr>
<tr>
<td>H)</td>
<td>Earthing</td>
</tr>
<tr>
<td>I)</td>
<td>Lightning Protection System</td>
</tr>
<tr>
<td>J)</td>
<td>HV Cables</td>
</tr>
<tr>
<td>K)</td>
<td>Bus Duct</td>
</tr>
</tbody>
</table>
A) WIRING

1.0 GENERAL

Technical specifications in this section cover item of wiring installations comprising of:

Point wiring including circuit wiring for light, fan and call bell points as also lighting and power
convenience socket outlet points in concealed/surface conduit.

Submain wiring in concealed/surface conduit.

2.0 STANDARDS AND CODES

All equipments, components, materials and entire work shall be carried out in conformity with
applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended upto date
and as below. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity
Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not
available, relevant British and /or IEC Standards shall be applicable.

Equipments certified by Bureau of Indian Standards shall be used in this contract in line with
government regulations. Test certificates in support of this certification shall be submitted, as
required.

It is to be noted that updated and current standards shall be applicable irrespective of dates
mentioned along with ISS’s in the tender documents.

650/1100 V grade PVC insulated wires. 694 : 1990
Rigid MS Conduits for electrical wiring. (1983) IS 9537 Part –III
Flexible steel conduits for electrical wiring IS 3480 : 1966
Switch socket outlets IS 3480 : 1966
Switches for domestic and similar purposes IS 3854 : 1966
Boxes for the enclosure of electrical accessories IS 5133 : 1969
Code of Practice for Personal Hazard Fire Safety of Buildings IS 1644: 1960
Code of Practice for Electrical Installation Fire Safety of Buildings IS 1646 : 1982
Code of Practice for Electrical Wiring Installations IS 732 : 1989
3.0 CONDUITING

3.1 MS Conduits

The electrical wiring shall be done in recessed MS Conduits, unless mentioned otherwise.

Conduit work shall be carried out using ISI marked medium grade MS Conduits conforming to IS:9537 Part -III. The interior of the conduit shall be free from obstructions.

No conduit less than 25 mm in diameter shall be used.

3.2 Installation of MS Conduits:

i) The erection of conduits of each circuit shall be completed before the cables are drawn in.

ii) All joints shall be sealed /cemented with approved solvent cement. Damaged conduit pipes/fittings shall not be used in the work. Cut ends of conduit pipes shall have not sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes.

iii) No bends shall be used which are formed either by bending the pipes by heating. All accessories such as bends, elbows or similar fittings etc. shall be of factory made only. Radius of bends in conduit pipes shall not be less than 7.5 cm. No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet. Care shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that the internal diameter is not effectively reduced.

3.2 PVC Conduits:

Wiring shall be carried out in recessed /surface PVC conduits. The PVC conduits conform to IS 9537 Part-III and shall be ISI embossed. The conduits shall be heavy gauge (minimum 2 mm wall thickness) and the interiors of the conduits shall be free from all obstructions. All joints in conduits shall be sealed /cemented with approved solvent cement. Damage conduits/fittings shall not be used. Cut ends of conduits shall not have sharp edges.

3.3 Bends:

As far as possible, the conduit system shall be so laid out that it shall obviate 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.

3.4 Conduit Accessories:

The conduit wiring system shall be complete in all respects, including their accessories.

Bends, couplers etc. shall be solid type in recessed type of works and may be solid or inspection type as required, in surface type of works. The accessories shall conform in all respects to the relevant ISS. Samples shall be got approved by EMPLOYER before use.
3.4.1 Standard accessories

Heavy duty black enamel painted standard conduit fittings and accessories like standard/extra-deep circular boxes, looping in boxes, junction boxes, PVC bends, PVC solid elbows, solid/inspection tees, couplers, nipples, saddles, check nuts, earth clips, ball screwed with approved quality screws shall be used. Superior quality screwed PVC bushes shall be used. Samples of all conduits fittings and accessories shall be got approved by Project Manager before use.

3.4.2 Fabricated accessories

Wherever required, outlet/junction boxes of required sizes shall be fabricated from 1.6 mm thick MS sheets excepting ceiling an outlet boxes which shall be fabricated from minimum 3 mm thick sheets. The outlet boxes shall be of approved quality, finish and manufacture, Suitable means of fixing connectors etc. if required, shall be provided in the boxes. The boxes shall be protected from rust by zinc phosphate primer process. Boxes shall be finished with minimum 2 coats of enamel paint of approved cooler. A screwed brass stud shall be provided in all boxes as earthing terminal.

3.4.2.1 Outlet Boxes For Light Fittings

These shall be minimum 75mm x 75mm x 50mm deep and provided with required number of threaded collars for conduit entry. For ceiling mounted florescent fittings, the boxes shall be provided 300 mm off centre for a 12mm fitting and 150 mm off centre for a 600 mm fitting so that the wiring is taken directly to the down rod. 3mm thick Perspex/hylam sheet cover of matching colour shall be provided.

3.4.2.2 Outlet Boxes For Ceiling

Outlet boxes for ceiling fans shall be fabricated from minimum 3mm thick MS sheet steel. The boxes shall be hexagonal in shape of minimum 100mm depth and 60mm sides. Each Box shall be provided with a recessed fan hook in the form of one ‘U’ shaped 15mm dia rod welded to the box and securely tied to the top reinforcement of the concrete slab for a length of minimum 150 mm on either side. 3mm thick Perspex/hylam sheet cover of matching colour shall be provided.

3.4.3 Boxes For Modular Wiring Accessories

3.4.3.1 Switch Boxes Modular Type

Switch boxes suitable to house modular type switches of required ratings, and fan regulators as required shall be provided in case the number of switches in one box is not tallying with that available in standard manufacture, the box accommodating the next higher number of switches shall be provided without any extra cost. In case fan regulator/regulators is/are to be provided at a later dated, suitable provision for accommodating such regulators shall be made in the switch boxes and blank off covers shall be provided without any extra cost.

Switch boxes shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, check nuts and screwed bushes at conduit entries etc. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be attached to conduits by means of inserting the conduits in the outlet boxes. Extra length of conduit shall be cut off inside the box.
with the help of cutting blade. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be fixed by means of counter sunk chromium plated brass machine screws. No timber shall be used for any supports. Switch boxes shall be located with bottom at 1200mm above floor level unless otherwise indicated.

3.4.3.2 Modular Type Boxes For Socket/Telephone/Call Bell Outlets

Outlet boxes shall be suitable for housing modular type switched socket outlets/ telephone outlets/ buzzers and any other outlet as required. These shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be cut off inside the box with the help of cutting blade. Moulded front covers made from high impact, resistant, flame retardant and ultra violet stabilized engineering plastics shall be used to mount the outlets and shall be fixed to the outlet M.S. boxes by means of counter sunk chromium plated brass machine screws. No timber supports shall be used. Boxes shall be located at skirting level or bottom at 1200mm from floor or inside raceways on laboratory work tables. As indicated in drawings /or as directed.

3.5 Sheet Metal Outlet/Draw/Inspection/Junction Boxes.

3.5.1 General

Wherever required, outlet boxes of required sizes shall be fabricated from 1.6 mm thick MS sheets excepting ceiling fan outlet boxes which shall be fabricated from minimum 2 mm thick sheets. Outlet boxes shall be provided with minimum 16 mm projected threaded collars. The outlet boxes shall be of approved quality, finish and manufacture. All outlet boxes shall be provided with an earth stud. The boxes shall be protected from rust by zinc phosphate primer process. For concealed conduiting work, boxes with primer only could be embedded. For surface conduiting work, the boxes shall be finished with minimum one coat of enamel paint of approved colour. The outlet boxes shall be so protected at the time of fixing that no mortar find its way inside during concrete filling or plastering. For concealed conduiting work, outlet boxes shall be completely embedded in walls/ceilings leaving edges flush with finished wall/ceiling surface.

3.5.2 Switch/Socket Outlets Boxes - Modular Type

Boxes suitable to house modular type switches/sockets of required ratings, and fan regulators as required shall be provided. In case the number of switches in one box is not tallying with that available in standard manufacture, the box accommodating the next higher number of switches shall be provided without any extra cost. In case fan regulator/regulators is /are to be provided at a later stage, suitable provision for accommodating such regulators shall be made in the switch boxes and blank off covers shall be provided without any extra cost. The outlet boxes shall be of MS having external and internal surface true to finish. All boxes shall have adequate number of knock out holes of required diameter and earth stud. Unless otherwise stated boxes shall be located with bottom at 1200 mm above finished floor level.

3.5.3 Outlet Boxes For Light Fittings.

These shall be minimum 75mm x 75mm x 50mm deep and provided with threaded collars for conduit entry as required. For ceiling mounted florescent fittings, the boxes shall be provided.
Alimco Township Village Hora Bangar, Kanpur (UP)

300 mm off centre for a 1200 mm fitting and 150 mm off centre for a 600 mm fitting so that the wiring is taken directly to the down rod. 3 mm thick Perspex / hylam sheet cover of matching colour shall be provided.

3.5.4 Draw Boxes

Draw boxes of minimum 75mm x 75mm x 50mm deep or larger as required shall be provided at convenient locations to facilitate drawing of long runs of conductors. These shall have screwed covers of 3mm thick Perspex / hylam sheet.

Inspection Boxes / Junction Boxes

Inspection boxes of minimum 75mm x 75mm x 50mm deep shall be provided at suitable location in conduit runs to permit inspection and maintenance. These shall have screwed covers of 3mm thick perspex/hylam sheet.

3.6 Cross Section

The conduits shall be of ample sectional area to facilitate simultaneous drawing of wires and permit future provision also. Total cross section of wires measured overall shall not normally be more than half the area of the conduit.

3.7 Laying of Conduits

Conduits shall be laid either concealed in walls and ceilings or on surface on walls and ceilings or partly concealed and partly on surface, as required. Same rate shall apply for concealed and surface conduiting in this contract.

3.7.1 Concealed Conduiting

Concealed conduits in concrete members shall be laid before casting, in the upperportion of slabs or otherwise as may be instructed, so as to embedd the entire run of conduits and ceiling outlet boxes with a cover of minimum 12mm concrete. Conduits shall be adequately tied to the reinforcement to prevent displacement during casting at intervals of maximum 1 meter. No reinforcement bars shall be cut to fix the conduits. Suitable flexible joints shall be provided at all locations where conduits cross expansion joints in the building.

Concealed conduits in brick work shall be laid in chases to be cut by electrical Contractor in brick work before plastering. The chases shall be cut by a chase cutting electric machine. The chases shall be of sufficient width to accommodate the required number of conduits and of sufficient depth to permit full thickness of plaster over conduits. The conduits shall be secured in the chase by means of suitable clamps at intervals of maximum 1 meter. The chases shall then be filled with cement and coarse sand mortar (1:3) and properly cured by watering. Chicken wire mesh shall be used for closing the chases with cement plaster.

Entire concealed conduit work in concrete members and in brick work shall be carried out in close coordination with progress of civil works. Conduits in concrete members shall be laid before casting and conduits in brick work shall be laid before plastering. Should it become necessary to embeded conduits in already cast concrete members, suitable chase shall be cut in concrete for
the purpose. For minimizing this cutting, conduits of lesser diameter than 25 mm and outlet boxes of lesser depth than 50 mm could be used by the Contractor for such extensions only after obtaining specific approval from EMPLOYER. For embedding conduits in finished and plastered brick work, the chase would have to be made in the finished brick work. After fixing conduit in chases, chases shall be made good in most workmanlike manner to match with the original finish.

Cutting chases in finished concrete or finished plastered brick work for embedding conduits and outlet boxes etc shall be done by the Contractors without any extra cost.

### 3.7.2 Surface Conduiting

Wherever so desired, conduits shall be laid on surface over finished concrete and/or plastered brickwork. Suitable spacer saddles of approved make and finish shall be fixed to the finished structural surface along the conduit route at intervals not exceeding 600 mm. Holes in concrete or brick work for fixing the saddles shall be made neatly by electric drills using masonry drill bits. Conduits shall be fixed on the saddles by means of good quality heavy duty MS clamps screwed to the saddles by counter sunk screws. Neat appearance and good workmanship of surface conduiting work is of particular importance. The entire conduit work shall be in absolute line and plumb.

### 3.8 Painting of Conduits and Boxes

All draw/ switch/ junction/ fan-hook boxes shall be painted with red oxide/galvanized/zinc passivated in their manufactured form. All ungalvanized / unplated boxes shall be again painted with red oxide paint as required before fixing. Boxes fixed on surface shall, in addition, be painted with finishing paint of approved colour and finish.

### 3.9 Protection of Conduits

To safeguard against filling up with mortar/plaster etc. all the outlet and switch boxes shall be provided with temporary covers and plugs which shall be replaced by sheet/plate covers as required. All screwed and socketed joints shall be made fully water tight with white lead paste.

### 3.10 Cleaning of Conduit Runs

The entire conduit system including outlets and boxes shall be thoroughly cleaned after completion of erection and before drawing in of cables.

### 3.11 Earthing

Continuous earth wire shall be provided for all points, outlets and sub-mains. Earthing terminals shall be provided inside all switch boxes, outlet boxes and draw boxes etc.
4.0 WIRES

4.1 Material

Wires shall be PVC insulated with stranded copper conductors, unless otherwise stated, of 650/1100 volt grade, conforming to IS : 694 - 1990. All wires shall bear manufacturer’s label and shall be brought to site in new and original packages. Manufacturer’s certificate, certifying that wires brought to site are of their manufacture shall be furnished as required.

cable specifications

The coaxial cables shall be of wideband type with operation up to 300 MHz capability. Aging resistance shall comply with DIM 472.52 part 2 e.i. maximum 5% increase in attenuation at 200 MHz measured by artificial aging (14 days at 800 C) cables shall meet all exceed following specifications.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center core Dia</td>
<td>0.8mm</td>
</tr>
<tr>
<td>Dielectric Dia</td>
<td>4.8 mm</td>
</tr>
<tr>
<td>Dielectric PE</td>
<td></td>
</tr>
<tr>
<td>Outer Conductor Dia</td>
<td>5.4 mm</td>
</tr>
<tr>
<td>Outer Dia</td>
<td>7.0 mm</td>
</tr>
<tr>
<td>Bending radius</td>
<td>more than 30 mm</td>
</tr>
<tr>
<td>Impedance</td>
<td>75 ohms</td>
</tr>
<tr>
<td>D.C. Resistance</td>
<td>50 ohms /KM</td>
</tr>
<tr>
<td>Screening factor</td>
<td>more than 50</td>
</tr>
<tr>
<td>Attenuation</td>
<td></td>
</tr>
<tr>
<td>50 Mhz</td>
<td>6.5</td>
</tr>
<tr>
<td>100 Mhz</td>
<td>9</td>
</tr>
<tr>
<td>200 Mhz</td>
<td>13</td>
</tr>
<tr>
<td>300 Mhz</td>
<td>16</td>
</tr>
</tbody>
</table>

4.2 Bunching of Wires

Wires carrying current shall be so bunched in conduits that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

4.3 Drawing of Wires

The drawing of wires shall be executed with due regard to the following:-

No wire shall be drawn into any conduit, until all work of any nature that may cause injury to wires is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Bushes shall be provided at conduit edges.

Before the wires are drawn conduits, conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits if necessary.
While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which could cause breakage of conductors.

There shall be no sharp bends.

**4.4 Termination /Jointing of Wires**

Sub-circuit wiring shall be carried out in looping system. Joints shall be made only at distribution board terminals, switches/buzzers and at ceiling roses/connectors/lamp holders terminals of lights/ fans/ socket outlets. **No joints shall be made inside conduits or junction/ draw/ inspection boxes.**

For wiring of lighting circuits, looping of neutrals should be done preferably at switch board. Terminating strips should be used for neutral and live conductors. For connecting the switches to the terminating strips short length flexible PVC insulated wires should be used.

If looping of neutral at switch board is not feasible, then terminating strip should be used at junction boxes. Sizing of the junction boxes should be done accordingly.

Wiring conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any specified reasons shall be made by approved connectors. Specific prior permission from EMPLOYER in writing shall be obtained before making such joint.

Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or wringing.

Strands of wires shall not be cut for connecting terminals. All strands of wires shall be soldered at the end before connection.

Conductors having nominal cross sectional area exceeding 4 sq. mm shall always be provided with crimping sockets.

At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used.

Brass nuts and bolts shall be used for all connections.

The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.

Switches controlling lights, fans, socket outlets etc. shall be connected to the phase wire of circuits only.

Only certified wiremen shall be employed to do wiring / jointing work.

**4.5 Load Balancing**

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

**4.6 Colour Code of Conductors**
Colour code shall be maintained for the entire wiring installation - red, yellow, blue for three phases, black for neutral and green for earth.

5.0 SWITCHES/SOCKET OUTLETS

5.1 Switches

All 6 and 16 amps switches shall be of modular flush mounting type, unless otherwise stated, suitable for 250 volt AC supply, best quality and of approved make. The switch moving and fixed contacts shall be of silver nickel and silver graphite alloy and contact tips coated with silver. Housing of switches shall be made from high impact resisting flame retarding and ultra violet stabilized engineering plastic materials. Switches shall be fixed inside the box on adjustable MS strips/plates with tapped holes brass machine screws, leaving ample space at the back and side for accommodating wires.

5.2 Combination Outlets:

6A 3 pin / 2 pin combination outlets mounted on switch boards along with other lighting control switches. Each such outlets will have a corresponding controlling switch mounted next to the outlet. Such outlets may be looped into the corresponding lighting circuit.

5.3 Socket Outlets

6/16 amps socket outlets shall be of modular flush mounting type, unless otherwise stated, and shall be switched, three pin type and fitted with automatic linear safety shutters to ensure safety from prying fingers. Socket outlets shall be made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material.

Switches and sockets shall be located in the same plate. Plates for 6 amp switched/ unswitched power and telephone outlets shall be of the same size and shape.

An earth wire shall be provided along the wires feeding socket outlets for electrical appliances. The earth wire shall be connected to the earthing terminal screw inside the box. The earth terminal of the socket shall be connected to the earth terminal provided inside the box.

5.4 Flush Plates

Switches, socket outlets, receptacles, and telephone outlets etc.. in walls shall be provided with moulded modular cover plates of approved colour, shape and size made from high impact resistant, flame retarding Polycarbonate and secured to the box with counter sunk /round head chromium plated brass screws unless otherwise stated. Where two or more switches are installed together, they shall be provided with one common switch cover plate as described above with notches to accommodate all switches either in one, two or three rows.

One and two gang switch cover plate, telephone outlet cover plate, 6 and 16 amps switched/ unswitched outlet plates, shall have the same shape and size. Three and four gang switch cover plates shall have the same shape and size. Six and eight gang switch cover plates shall have the
same shape and size. Nine and twelve switch cover plates shall have the same shape and size. Wherever five switches, seven switches, ten switches and eleven switches are to be fixed the next higher size of gang switch cover plate to be used and extra openings shall be provided with blank-offs without extra cost.

5.5 Lighting Fixtures

Light fixtures and fittings shall be assembled and installed complete as required and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the EMPLOYER.

Wires brought out from junction boxes shall be encased in G.I. flexible pipes for connecting to fixtures concealed in suspended ceilings. Flexible pipes shall be provided with a checknuts at both ends.

Pendant fixtures specified with overall lengths are subject to change and shall be checked with site conditions and installed as required.

All suspended fixtures shall be mounted rigid and fixed in position in accordance with drawings, instructions and as approved by architect/Corporation.

Fixtures shall be suspended true to alignment, plumb, level and capable of resisting all lateral and vertical forces.

All suspended light fixtures, fans etc. shall be provided with concealed suspension arrangement in the concrete slab/roof members. Making provisions for such arrangements at the appropriate stage of construction is deemed to be included in contractors’ scope . Exhaust fans shall be fixed at locations shown on the drawings. They shall be wired to a plug socket at a convenient location near the fan in flexible conduits.

All switch and outlet boxes, and fan regulators shall be bonded to earth with PVC insulated stranded copper wire as specified.

Wires shall be connected to all fixtures through connector blocks.

Flexible conduits, wherever used, shall be of make and quality approved by EMPLOYER.

6.0 POINT WIRING

6.1. Measurement and payment

Wiring for light, ceiling fan, exhaust fan, socket outlet and telephone outlet points, carried out as per tender specification, shall be measured and paid on point basis only. No part of point wiring items shall be paid on linear basis. Rates quoted for point wiring items shall be based on parameters stipulated in para 6.2 below. Average wiring length and average conduiting length forming the basis of point wiring rates, shall take the electrical layouts of the entire project into consideration. Tenderers are advised to seek clarifications, if they so desired, on this aspects before submitting tenders. No claim for extra payment on account of electrical layouts in parts of projects requiring larger average wiring and
conduit length per point, whether specifically shown in tender drawings or not, shall be entertained after the award of contract.

6.2 Primary and Secondary light point wiring

In respect of group control of lights (more than one light controlled by one switch or MCB), wiring up to the in respect of group shall be measured and paid for as a primary light point. Wiring for other lights looped in one group for switch controlled as also MCB controlled lights shall be measured and paid for as secondary light points. For switch controlled lights shall include the cost of control switch whereas primary light points controlled by MCBs shall not include the switch cost. The cost of MCB shall be paid for in the item of DB.

The point wiring shall assume average wiring length and average conduiting length per point based on parameters stipulated in para 9.2 below. The average wiring length and average conducting length forming the basis of point wiring payment shall take the electrical layouts of the entire project into consideration. Tenderers are advised to seek clarifications, if they so desire, on this aspect before submitting their tenders. No claim for extra payment on account of electrical layouts in part or whole of the project requiring larger average wiring and conduiting length per point, whether specifically shown in tender drawings or not, shall be entertained after the award of contract.

6.3 Parameters

Point wiring shall be carried out as per following parameters.

In concealed/surface conduit system unless otherwise stipulated.

Only looping system of wiring shall be adopted through-out.

All accessories shall be flush type unless otherwise stated.

For estimation of load, following loads per point shall be assumed.

<table>
<thead>
<tr>
<th>Light points</th>
<th>60 Watts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 amps socket outlet points</td>
<td>100 Watts.</td>
</tr>
<tr>
<td>Fan points</td>
<td>60 Watts.</td>
</tr>
<tr>
<td>Exhaust fan points</td>
<td>150 Watts or as specified.</td>
</tr>
<tr>
<td>16 amp socket outlet points</td>
<td>1000 Watts.</td>
</tr>
</tbody>
</table>

Light points, fan points and 6 amp socket outlet points may be wired on a common final such circuit. Such circuit shall not normally have more than a total of 10 light, fan or socket outlets or a load of 800 watts unless otherwise is stipulated. Wiring from DB to the first switch in each sub circuit is defined as circuit wiring which shall be wired with one size higher wire.

Power circuits shall normally have maximum one 16 amps socket outlet unless otherwise stated. Separate circuit shall be run for each geyser, kitchen equipment, window air conditioners and similar appliances.

Point wiring rates shall include painting of conduits and other accessories as required.
Point wiring rates shall include cleaning of dust, splashes of colour wash or paint from all fixtures, fans, fittings etc. at the time of taking over of the installation.

Rates quoted for wiring for groups of more than one light controlled by one switch shall be on the same basis as above excepting that the cost of interconnection looping wiring between the first light and subsequent lights controlled by one switch shall also be included in the point wiring rate.

Wiring for DB controlled groups of lights shall be done through MCB directly from DB. Control switches are not required and cost of MCB is also not included in the point wiring rate since this cost is included in the item of DB. Rates quoted for the DB controlled groups of lights shall be on the same basis as for switch controlled groups excepting that the cost of switches shall not be included.

6.4 Point wiring definitions

6.4.1 Wiring for Light points

Point wiring for light points shall commence at the distribution board terminals and shall terminate at the ceiling rose/connector in ceiling box/fixture terminal via the control switch. Rates quoted shall be deemed to be inclusive of the cost of entire materials and labour required for completion of point wiring thus defined including:

a) conduting system complete with all accessories, junction, draw/inspection boxes, bushes, check nuts etc. complete as required,

b) Wiring with stranded copper PVC insulated 660/1100 volt grade wires for point wiring including circuit wiring (wiring from distribution board terminals to the first switch in the sub-circuit) and terminations etc. complete as required.

c) Control switch with switch box and cover plate of specified type including fixing screws, earth terminal etc. complete as required

   c) Loop earthing with PVC insulated stranded copper wires complete as required.

Secondary Light points.

Secondary light points, as defined as above shall cover the cost of interconnection wiring between group controlled light fittings an shall be deemed to be inclusive of the cost of entire materials and labour for completion of the secondary light point thus defined including. Recessed/ surface conductung system wit all accessories, Junction/draw/inspection boxes, bushes, check nuts etc. complete as required, Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required. Loop earthing with insulated copper wires

6.4.2 Wiring for Ceiling Fans

Wiring for ceiling fan points shall be same as for primary light points and shall in addition, include ceiling outlet box with recessed fan hooks.
6.4.3 Wiring for Exhaust Fans

Wiring for exhaust fan points shall be same as for primary light points and shall in addition include the cost of providing a 3/5 pin 6 amp socket outlet near the fan along with plug top and a 6 amp control switch at convenient location near the room entry.

6.4.4 Wiring for Call Bell Points

Wiring for call bell points shall be the same as for primary light points and shall in addition include the cost of a call bell/buzzer of approved type and make in the required location and a call bell in lieu of the control switch at a convenient location as required.

6.4.5 Wiring for Telephone Outlets

Wiring for telephone outlets points shall include the entire wiring and conduiting from the telephone tag block to the telephone outlet including the telephone outlet complete as required and as itemized in the schedule of Quantities.

6.4.6 Wiring for TV Outlets

Wiring for TV outlet points shall include the entire wiring and conduiting from the central point to the TV outlet including the TV outlet complete as required and as itemized in the Schedule of Quantities.

6.4.7 Wiring for Convenience Socket Outlets

3/5 pin 6 amps and 3/6 pin 16 amps single phase switched convenience socket outlets shall be provided in the building as indicated in the layout drawings. In addition, combined 3 pin 6/16 amps socket outlets at modular intervals in special PVC raceway over the work tables in laboratories shall be provided wherever required 20/32/50 amps single phase and 32/50 amps 3 phase outlets shall also be provided.

Wiring for 3/5 pin 6 amps convenience socket outlets

Point wiring for 3/5 pin 6 amps socket outlets (in locations other than over the laboratory work tables) on point wiring basis shall be the same as primary light point defined in para 8.3.1 and shall in addition include 3/5 pin 6 amp socket outlet with 6 amp control switch in MS box with cover. Including loop earthing or the third pin complete as required as itemized in scheduled of quantities.

Wiring for 3/6 amps convenience socket outlets

Point wiring for 3/6 pin 16 amps socket outlets (in locations other than over the laboratory work tables) on point wiring basis shall be the same as primary light point defined in para 8.3.1 and shall in addition include 3/6 pin 16 amp socket outlet with 16 amp control switch in MS box with cover including loop earthing of the third pin complete as required as itemized in scheduled of quantities.
6.4.8 Exhaust fan point

Wiring for exhaust fan points shall be same as for 5 pin 6 amp socket outlet point excepting that the socket outlet and the control switch shall not be in the same box. The socket outlet shall be located near the exhaust fan and the control switch shall be located near the light control switches of the room.

6.4.9 SUB-MAIN WIRING

Sub-main wiring shall comprise of stranded copper conductor PVC insulated 1100 volt grade wires in MS Conduits including loop earthing, terminations etc. complete as required.

Sizes of conduits, number/ type/size of wires and loop earthing shall be as stipulated in the schedule of quantities and/or drawings.
Wires shall be drawn in the concealed or surface conduits as required, without being damaged. For this purpose, draw boxes shall be located at convenient locations.

Every sub-main shall run in an independent conduit with an independent earth wire of PVC insulated stranded copper wire as specified running along the entire run of conduit. For single phase, one earth wire shall run and for three phase two earth wires shall run.

Necessary provision of wire lengths entering and emerging from the conduit shall be made for connections.

Measurement shall be taken of the actual conduit run containing the wires from one point to the other.

7. ROUTINE AND COMPLETION TESTS

7.1 Installation completion Tests

1. Wiring continuity test
2. Insulation resistance test
3. Earth continuity test
4. Earth resistivity test

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor his own cost.

7.2 Wiring Continuity Test

All wiring systems shall be tested for continuity of circuits, and earthing after wiring is completed an before installation is energized.

7.3 Insulation Resistance Test

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all protection in place and all switches closed except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a
direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volt for medium voltage circuits.

Where the supply is derived from AC three phase system the neutral pole of which is connected the earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 mega ohms divided by the number of point provided on the circuit the whole installation shall not have an insulation resistance lower than one mega ohm.

The insulation resistance shall be measured between all conductors connected to one phase conductor of the supply and be carried out after removing all metallic connections between he two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant standard specification or where there is no such specification, shall not be less than half a mega ohm or when PVC insulated cables are used for wiring 12.5 mega ohms divided by the number of outlets. Where a whole installation in being tested a lower value than that given by the above formula subject to a minimum of 1 Mega ohms is acceptable.

7.4 Testing of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

7.5 Testing of Polarity Of Non-Linked Single Pole Switches

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non earthed conductor of the supply. In the three of four wire installation, a test shall be made to verify that every non linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Project Manager as well as the local authorities.

7.6 Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

7.7 Performance

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.
7.8 Tests And Reports

The Contractor shall furnish test reports and preliminary drawings for the equipment to the project Manager for approval before commencing supply of the equipment. The contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc. required by the local inspectors or any other Authorities would be supplied by the Contractor without any extra charge. All test reports shall be approved by the Project Manager prior to energizing of installation.

C) DISTRIBUTION BOARDS:

1.0 GENERAL

Distribution board shall be suitable for 415 volts, 3 phase AC supply or 230 volts single phase AC supply as required. Distribution boards shall generally conform to IS 2675 or BS 214. However, the specifications hereinafter described shall take precedence over the above wherever this specifications call for a higher standard or material or workmanship.

2.0 TYPE AND CONSTRUCTION

Distribution boards shall be of totally enclosed dead front type. The enclosure shall be made of CRCA sheet steel of not less than 2mm thickness. The sheet steel shall be folded and braced as necessary to provide a rigid supports for all components. The distribution boards shall comprise of miniature circuit breaker as incoming and required number of miniature circuit breakers as outgoings. The main and outgoings shall have rating as specified on the drawings and schedule.

3.0 BUS BARS

Suitable bus bars made of high conductivity copper strips and mounted on no hygroscopic insulating supports shall be provided. The current density for bus bars shall not exceed 1.8 Amps/Sq.mm of cross section area. Ends of the bus structures shall also be shrouded.

4.0 CABINET DESIGN

The cabinet shall be stove enameled to gray shade finish. The interior surface shall be finished to an off-white shade. The interior components shall be mounted on a separate sheet steel which is mounted and locked on to the studs provided inside the cabinet. Over this, a cover made of hylam sheet or stove enameled sheet steel shall be provided with slots for operating handles of breakers. The cabinet shall be equipped with a front door having a spring latch and a vault lock. Cabinets shall have detachable gland plates at both top and bottom.

5.0 TERMINALS

Distribution boards shall be provided with a terminal block of adequate size to receive mains and outgoing circuits. The location of the terminal block shall be so located that crowding of wires in the proximity of live parts is avoided. A neutral link having rating equal to that of phase bus shall be provided.
Earth bus for termination of earth wires and earthing studs shall be provided in the Distribution Board.

6.0 INSTALLATION

The distribution boards shall be suitable for surface mounting until and unless Bill of Quantities specifies recessed mounted Distribution Boards.

7.0 TESTING

Distribution boards shall be tested at factory as per IS 2675 or BS 214. The tests shall include insulation test, high voltage tests etc. Distribution boards shall be tested for insulation resistance after the erection.

The Distribution boards shall be factory made as per the manufacturer.

8.0 MINIATURE CIRCUIT BREAKERS

The MCB’s shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system. MCB’s shall be quick make and break type conforming to relevant IS. Housing shall be heat resistant and have a high impact strength. MCB’s shall be flush mounting type and shall be provided with trip free manual operating lever with ON/OFF indications.

MCB’s shall be provided with magnetic thermal releases for overcurrent and short circuit protection. The overload or short circuit device shall have a common trip bar in case of DP and TPN MCB’s. The MCB’s shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with H.R.C. fuse/PVC cable characteristic.

The MCB’s shall have a minimum breaking capacity of 10 kA at 230/415 volts in accordance with IEC : 898 - 1995 and IS : 8828 – 1996

9.0 MOULDED CASE CIRCUIT BREAKERS

9.1 GENERAL

Moulded case circuit breakers shall be incorporated in the switch board wherever specified. MCCB shall conform to IEC:947-II or IS:13947-II in all respects. MCCB shall be suitable for three phase 415 volts AC. Suitable discrimination shall be provided between upstream and downstream breakers in the range of 10-20 milli seconds. All MCCBs will have earth fault module (if specifically asked) and front operated. All four pole MCCB shall be suitable for three phase four wire system, with the neutral clearly identified and capable of first make last break feature.

9.2 CONSTRUCTION

The MCCB cover and case shall be made of high strength heat-resistant and flame retardant thermosetting insulating material, operating handle shall be quick make/quick break. The operating handle shall have suitable ‘ON' `OFF' and 'TRIPPED' mechanical indicators notable from outside. All MCCBs shall have a common operating handle for simultaneous operation and tripping of all the three phases. The MCCB should be suitable.
for disconnection and isolation with marking on front name plate.

Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be thermal-magnetic type provided on each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. Thermal magnetic tripping device shall have IDMT characteristics for sustained over load and short circuits. All MCCBs above 250 Amps will also have short circuit magnetic pickup level adjustment.

9.3 MCCBs

All MCCBs shall have variable thermal overload releases which can be adjusted at site.

Contact tips shall be made of suitable arc resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearances. All MCCBs of higher ratings above 250 Amps, shall be provided with separate extended arcing contacts.

9.4 INTERLOCKING

Moulded case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switch board.

a) Handle interlock to prevent unnecessary manipulations of the breaker.
b) Door interlock to prevent the door being opened when the breaker is in ON or OFF position.
c) Defeat-interlocking device to open the door even if the breaker is in ON position.

9.5 BREAKING CAPACITY

The moulded case circuit breaker shall have a rated service. Short circuit breaking capacity of not less than 25 KA rms at 415 volts AC. Wherever required, higher breaking capacity breakers to meet the system short circuit fault shall be used.

9.6 ACCESSORIES

All the accessories like shunt, undervoltage contact blocks shall be of snap fitting possible at site.

9.7 TESTING

a) Original test certificate of the MCCB shall be furnished.

b) Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.
D) TELEPHONE WIRING SYSTEM:

1.0 SCOPE :

This section relates to specification for the supply, installation, testing & commissioning of works included in electrical section for telephone system. The scope of work included in this section is as follows:

a) Supply and installation of cables/wires G.I. fabricated perforated cable trays for laying telephone from the telephone exchange room upto each floor. (Cable tray quantity covered in cabling works).

b) Providing & installing cable ladders in the telephone vertical duct from Ground floor upto 2nd floor in each block of the building (Quantity covered in cabling works).

c) Providing & installing MS/PVC conduits run from corridor to each office unit /Guest room to connect between cable tray & the telephone tag block.

d) Providing conduits for telephone wiring in the public areas with G.I. fish wire.

e) Providing & installing GI/PVC moulded boxes including plugin type telephone outlets in public/Guest office areas.

f) Providing & installing pipe sleeves for P&T incoming lines into the EPABX room if required.

The electrical contractor shall co-ordinate with P & T and other agencies to finalize the exact requirement.

2.0 CONDUITING :

2.1 All concealed /surface installation including the conduit run above the false ceiling space shall be heavy gauge black enameled MS/PVC Conduit. The specification for materials & installation shall be same as described in electrical section. All relevant clauses are applicable for telephone system as well. The conduit for telephone system shall be installed minimum 20 cm away from the power conduit. Care shall be taken so that no telephone conduit is run in parallel to Electrical conduit in close proximity. Wherever telephone conduits cross power conduits, they shall be at right angle, to each other. All telephone conduits shall be earthed.

**Size of Cable Conduit Size**

<table>
<thead>
<tr>
<th>Size of Cable Conduit</th>
<th>Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5 pair</td>
<td>20 mm</td>
</tr>
<tr>
<td>Above 5 pair up to 10</td>
<td>25 mm</td>
</tr>
<tr>
<td>Above 10 pair up to 20</td>
<td>32 mm</td>
</tr>
<tr>
<td>2 Nos. 2 pair</td>
<td>20 mm</td>
</tr>
<tr>
<td>3 to 5 Nos. 2 pair</td>
<td>25 mm</td>
</tr>
<tr>
<td>6 to 10 Nos. 2 pair</td>
<td>32 mm</td>
</tr>
</tbody>
</table>
The size of conduit shall depend upon no. of wires to be drawn. However minimum size of conduits shall be 19/20 mm.

2.2 All telephone wires shall be 0.61 mm dia annealed tinned copper conductor PVC insulated and PVC sheathed cables. All telephone cables inside the building shall be un-armoured Each outlet shall be wired with 2 pair cables from final tag unless otherwise specified separately. From main tag block to sub tag block cabling shall be done with suitable size of telephone un-armoured cable laid in conduit/pipe/ cable trays.

3.0 CABLE TRAYS:

The specification & installation method described in the other section of electrical specification shall be applicable.

4.0 BOXES & TELEPHONE OUTLETS:

All concealed boxes shall be of G.I. as described in the electrical wiring section & shall match with electrical wiring accessories. The boxes/main Junction box shall be suitable for wall mounting having opening for cable/ conduit entry. All PVC cable shall enter the telephone junction box from the bottom through brass cable glands and enough cable length shall be available for termination.

Each PVC cable serving the telephone socket shall be marked for identification.

Junction boxes shall be fully enclosed, kept tight with lockable hinged doors. Prior to the system installation the contractor shall consult telephone department for their requirements and notify the Construction manager/Consultants on the same. All equipment like tag blocks, wires shall be MTNL approved makes.

5.0 SUPPLY OF MATERIALS:

Exclusions:

a) Telephone Exchange & Telephone instruments.

b) Main incoming cable.

Rest all material for distribution of telephone system as covered in BOQ shall be in the Contractors scope.

The telephone outlet shall be plug-in (clip on) type socket outlet. The switch plate shall be similar to the electrical wiring devices.

4.0 Directional Couplers

4.1 These shall be of Ultra Wideband type and of hybrid circuit design.

4.2 These shall have a near flat frequency response over the entire operating range.

4.3 These shall have an aluminium cast housing for high frequency radiation resistance.

4.4 These shall have ‘F’ sockets for all input, output and branch ports.
4.5 The Tap offs shall be available in one way, two way and four way configurations.

4.6 The splitters shall be available in two way, three way and four way configurations.

4.7 The Tap offs shall be available in different tap values ranging from 11 dB, 15 dB, 20 dB, 25 dB and 30 dB.

4.8 These shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th></th>
<th>Tap offs</th>
<th>Splitters</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Tap Loss</td>
<td>11-30 dB</td>
<td>----</td>
</tr>
<tr>
<td>b) Through Loss</td>
<td>0.5-4 dB</td>
<td>4.0 – 8.0</td>
</tr>
<tr>
<td>c) Isolation</td>
<td>&gt;22 dB</td>
<td>&gt; 22 dB</td>
</tr>
<tr>
<td>d) Screening Factor</td>
<td>&gt; 50 dB</td>
<td>&gt; 50 dB</td>
</tr>
</tbody>
</table>

**F) EXTERNAL LIGHTING:**

The specifications covers the supply, installation, testing and commissioning of the following items:

- Street/Boundary lighting poles complete with all accessories e.g. looping box, clamps and required hardware’s etc.
- Street/boundary lighting fixtures complete with all accessories e.g lamps latest etc.
- Wiring of street light fixtures.
- Cable laying, earthing and inter connection
- Foundation of poles and erection.
- All the items should be tested and installed as per the latest Indian standards specifications and all the sundry items such as clamps, bolts, nuts, racks, support miscellaneous wiring etc., required to make the installation complete shall be taken care while quoting the major items.

**a) Steel Tubular pole**

The poles for street lighting purpose shall be complete in all respects and shall confirm to IS: 2713 unless otherwise specified. All poles shall be complete with base plate of 400 mm x 400 mm x 10 mm thick welded to bottom. The poles shall be provided terminal box for looping in and looping out of cables and shall consists fuse / MCB as specified. The looping box shall be suitable for outdoor installation and complete with all hardware’s such as clamp, bolts, earthing studs, lockable door etc. and shall be paint also in the same manner as specified for poles. The poles shall be provided with two numbers of GI pipes of suitable dia for cable entry as shown in drawing. The poles shall be painted with two coats of red oxide primer on both outside and the portion of the pole below the ground before erection and two coats of aluminium paint of approved shade after erection over the exposed portion.
b) Erection of pole

While loading, transporting, unloading and erecting the poles care shall be taken so that the poles do not get bent. Out of shape and where necessary such defects shall be rectified before the poles are erected in position. The poles shall be erected in plumb line and correct level as indicated in the drawing and to the satisfaction of the Engineer-in-charge. They shall be kept in this position with the help of manila ropes until the foundation are constructed (for a minimum period of 10 days) and the back filling is complete. Foundation shall be made with reinforced cement concrete (1:2:4) and not less than 200 mm thick all round. The pole base plate shall be fixed over 150 mm thick concrete bed. Foundation shall be continued up to 300 mm or more above ground level as per location of the pole to avoid ingress of water logging etc. The foundation shall be tapered suitably into a collar. The excavated portion shall be filled back with earth and consolidated. The cement concrete foundations shall be cured properly by covering the same with water soaked or moist gunny bags at least two weeks before loading the pole.

c) Erection of light fixtures

Each light fixture shall be connected to the supply through fuse/MCB of a suitable rating mounted in the looping box. The fitting shall be fixed to the pole properly and securely.

d) Wiring of light fixtures

The wiring of lighting fixtures from terminal block by means of 2.5 Sq.mm PVC insulated single core copper conductor through a suitable rated MCB/fuse and neutral. Cost of single core connecting cable from junction box to lighting fixture and earth wire complete with connections are included in the quoted rate.

e) Cabling works

All cable installation work shall be done as per relevant clauses of section cable work.

f) Tests

Before handing over the installation, tests on all fittings and cables shall be carried out as per IS specification.

The tests shall include:

a) Meggar test

b) Continuity test

c) Polarity test and phase sequence test
G) MEDIUM VOLTAGE CABLES

1.0 STANDARDS OF CODES

This chapter covers the specifications for supply and laying of Medium Voltage XLPE cables.

All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended upto date. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

2.0 DELIVERY, STORAGE AND HANDLING

Cables shall be delivered at site in original drums with manufacturer’s name clearly written on the drum.

Manufacturer’s recommendation particularly in respect of sealing shall be strictly followed.

Cable drum shall be stored on a well-drained, hard surface, preferably of concrete, so that the drums do not sink in ground causing rot and damage to the cable drum. The cable drum shall conform to latest IS.

During storage, periodical rolling of drums, in the direction of arrow marked on the drum, shall be done once in 3 month through 90° C.

Both ends of cables shall be properly sealed to prevent moisture ingress.

Drums shall be stored in well-ventilated area protected from sun and rain.

Drums shall always be rested on the flanges and not on flat sides.

Damaged battens of drums etc. shall be replaced.

Movement of drums shall always be in direction of the arrow marked on the drum.

For transportation over long distance, the drums shall either be mounted on drum wheels and pulled by ropes or they shall be mounted on trailers etc. drums shall be unloaded preferably by crane otherwise they shall be rolled down carefully on suitable ramps.

While transferring cable form 1 drum to another, the barrel of the new drum shall have diameter not less than the original drum.
Cables with kinks or similar visible defects like defective armouring etc shall be rejected.

Cables shall be supplied at site in cut pieces as per actual requirements.

3.0 CABLES
Medium voltage cables shall be aluminium conductor XLPE insulated, PVC sheathed armoured conforming to latest IS. Cables shall be rated for a 1100 Volts. The conductor of cables from 16 Sq. mm. to 50 Sq. mm. shall be stranded. Sector shaped stranded conductors shall be used for cables of 50 sq. mm and above. Conductors shall be made of electrical purity aluminium ¾ 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 un-vulcanized compound. Armouring shall be applied below outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer’s name and trade mark at every meter length. Cores shall be provided with following colour scheme of XLPE insulation.

1 Core : Red/Black/Yellow/Blue
2 Core : Red and Black
3 Core : Red, Yellow and Blue
3 ½ /4 Core : Red, Yellow, Blue and Black

4.0 LAYING OF CABLES

4.1 On Trays/Walls

4.1.1 Cable trays

Cable trays, of sizes as per schedule of quantities and drawings, shall be of doubled bend channel design unless otherwise stated. Cable trays shall be fabricated from minimum 2 mm thick perforated sheet steel and shall be complete with tees, elbows, risers, and all necessary hardware. Trays shall be galvanized or painted as specified. Cable trays shall be erected in perfect level and plumb and shall comply with the following:

Trays shall not have sharp edges, burrs or projections injurious to cable insulation.

Trays shall include fittings such as bends, risers etc. for changes in direction and elevation.

Trays shall be supported adequately at minimum 1 m distance from the building structure by means of painted/galvanized MS structural members secured to the structure by dash fasteners or by grouting. The entire cable tray system shall be rigid. Cost of support arrangement shall be included in the rates quoted for supply and installation of trays. Complete details of this support arrangement shall be shown in shop drawings to be prepared by the Contractors and submitted for Project Manager approval before execution. Works shall be carried out only as per approve shop drawing.

Each run of cable tray shall be completed before laying of cables.

Cable trays shall be exposed and accessible.
4.2 Buried Directly In Ground

4.2.1 Routing of the Cable Runs

Before cable laying work is undertaken, the route of the cables shall be decided in consulting with the Project Manager.

While shortest practicable route shall be preferred, cable runs shall follow fixed development such as roads, footpaths etc with proper off-sets so that future maintenance and identification are rendered easy.
Whenever cables are laid along well demarcated or established roads, the LV/MV cables shall be laid further from the kerb line than HV cables.

Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted, LV/MV cables shall be laid above HV cables.

Where cables cross one another, the cables of higher voltage shall be laid at a lower level than the cables of lower voltage.

Power and communication cables shall as far as possible cross at right angles. Where power cables are laid in proximity to communications cables the horizontal and vertical clearances shall not normally be less than 60 cm.

4.2.2 Route Markers

Route markers shall be provided along straight runs of the cables at locations approved and generally at intervals not exceeding 25 meters.

Markers shall also be provided to identify change in the direction of the cable route and also for location of every underground joint.

Route markers shall be made out of 100mm x 100mm x 5mm GI/aluminium plate welded or bolted onto 35 mm x 35 mm x 6 mm angle iron 600 mm long duly painted with anticorrosive paint. Such plate markers shall be mounted parallel to and 300 mm or so away from the edge of the trench/pipe/duct.

They shall be embedded in cement concrete 1:2:4 (one cement, 2 coarse sand : 4 graded stone aggregate of 30 mm normal size).

The word "Cable" and other details such as voltage grading, size etc as required shall be painted on the marker.

4.3 Laying of Cables in Floors

Laying of cables directly in floors shall be avoided and GI pipes of adequate size shall be used wherever necessary. However if the cables have to be laid direct in the floor specific written approval of Project Manager shall be obtained and the Contractor shall cut chases, lay the cables and make good the chases to original finish.
4.4 Cable Entry Into Buildings

Cable entry into buildings shall be made through RCC pipes recessed in the floor. RCC Hume pipes shall be provided well in advance for service cable entries. The pipe shall be filled with sand and sealed at both ends with bitumen mastic to avoid entry of water. Suitable size manholes shall be provided wherever required to facilitate drawing of cables as per requirements.

4.5 Cable Joints

Cable joints shall be resorted to and permitted only if length of cable root is more than standard cable drum length. Cable joints shall not be permitted in any other circumstances. Wherever unavoidable these joints shall be made with specific approval of Project Manager, and shall from a part of cable run.

4.6 Measurement of Cable Runs

The cable runs shall be measured up to the outer end of the boxes without any allowances for overlap in joints. The actual run of the cables shall be measured and the rate shall include all the above mentioned material, labour etc for laying as required.

4.7 Cable Loops

At the time of the installation approximately 3 meters of surplus cable shall be left as below or as directed by Engineer.

- at each end of the cable
- on each side of underground straight through/tee/termination joints.
- at entries to buildings

This cable shall be left in the form of a loop.

Wherever long runs of cable length are installed cable loops shall be left at suitable intervals as specified by the architect/clients.

5.0 TERMINATION/JOINTING OF CABLES

Soldered jointing/termination shall be totally avoided. Solderless terminations by using Dowel crimping tools and suitable lugs shall be adopted for all cable terminations. Double compression brass glands shall be used. Any termination without use of proper crimping tool shall be liable to be rejected. In the case of aluminium conductors, it is to be ensured that the conductor oxidation is cleaned by means of emery paper and then a thin coat of tin is applied before pinching into any equipment.
6.0 TESTING

6.1 Tests At Manufacturer’s Works

6.1.1 Type tests

Cables shall be subjected to type tests and acceptance test at manufacturers work as per latest IS code carried out in accordance with appropriate parts of latest amended upto date. Copies of the type test reports shall be furnished.

6.1.2 Routine test

Cables shall be subjected to routine test as per latest IS code.

a) Conductor resistance test

b) High voltage test at room temperature.

Copies of routine tests carried out at manufacturers works shall be furnished alongwith the cables

6.2 Testing at Site

6.2.1 Before laying

All cables before laying shall be pressure tested for one minute with 1000 volts megger. Cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armour and insulation resistance between conductors

6.2.2 After laying

After laying and jointing, cables shall be subjected to a 1.5 minutes AC/DC pressure test.

H) EARTHING

1.0 STANDARDS

IS 3043 1987 alongwith Rules Regulations, Directives, and Specifications stipulated in para 6.3 of these specifications shall apply.

2.0 GENERAL

All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits, trunking, cable sheaths, switchgear, distribution fuse boards, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing shall be in conformity with Indian Electricity Rules.
The Earthing System shall in totally comprise the following:-

a) Earth Electrodes

b) Earthing Leads

c) Earth Conductors

All three phase equipment shall have two separate and distinct body earths and single phase equipment shall have a single body earth.

3.0 EARTHING MATERIAL

Materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the schedule of quantities and shall comply to the following requirements:

a) Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian standard specifications.

b) Galvanised Steel - Galvanised steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309:1969.

c) The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

4.0 EARTH ELECTRODES

PLATE EARTH ELECTRODE

The plate electrodes shall be of copper/ GI as called for in the schedule of quantities. The minimum dimensions of the electrodes shall be 600 mm x 600 mm. Thickness of copper electrodes shall not be less than 3 mm and of GI electrodes not less than 6 mm.

The electrode shall be buried in ground with its face vertical and top not less than 3 metres below ground level.

EARTH ELECTRODE PIT

METHOD OF INSTALLING WATERING ARRANGEMENT

In the case of plate earth electrode, a watering pipe of 50 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 1000 x 500 x 500 mm. A cast iron/M.S. frame with cover having locking arrangement shall be suitably embedded in the masonry enclosure.
LOCATION OF EARTH ELECTRODE

The following guidelines shall be followed for locating the earth electrodes.

An earth electrode shall not be situated less than 1.5 metres from any building.

The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.

The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.

Entrances, pavements and road ways shall not be used for locating the earth electrode.

NUMBER OF EARTH ELECTRODES

In all cases the relevant provision of rule 33, 61 & 67 of the Indian Electricity Rules 1956 as amended shall be complied with.

Metallic covers or supports of all medium or H.T. apparatus or conductors shall, in all cases be connected to not less than two separate and distinct earth electrodes.

5.0 EARTHING LEADS

The strip earthing leads shall be connected to the Earth Electrode at one end and to the metallic body of the main equipment at the other end. The earthing lead shall connect to the earthing network in the installation.

EARTHING LEAD SIZES

Strip earthing leads shall be of copper/GI and as per specifications.

EARTHING LEAD INSTALLATION

The length of buried strip earthing lead shall be not less than 15 metres and shall be buried in trench not less than 0.5 m deep.

If conditions necessitates use of more than one earthing lead they shall be laid as widely distributed as possible preferably in a single straight trench or in a number of trenches radiating from one point.

METHOD OF CONNECTING EARTHING LEAD TO EARTH ELECTRODE

In the case of plate earth electrode the earthing lead shall be securely bolted to the plate with two bolts, nuts, checknuts and washers as required by IS 3043 : 1987.

All materials used for connecting the earth lead with electrode shall be GI in case of GI Pipe and GI plate earth electrodes or tinned brass in case of Copper plate electrode.
PROTECTION OF EARTHING LEAD

The earthing lead from electrode onwards shall be suitably protected from mechanical injury and corrosion by a

15 mm dia GI pipe in case of wire and
100/40 mm dia medium class GI Pipe

The portion of the G.I. pipe within ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing or pavements). The portion within the building shall be recessed in walls and floors to adequate depth.

6.0 EARTHING CONDUCTORS

Earthing conductors shall form the earthing network throughout the installation for earthing of all non-carrying metal parts.

CONNECTION OF EARTHING CONDUCTORS

a) Main earthing conductors shall be taken from the earth connections at the main switch boards to all other switchboards in the network.

b) Sub-mains earthing conductors shall run from the main switch board to the sub distribution boards and to the final distribution boards.

c) Loop earthing conductors shall run from the distribution boards and shall be connected to any point on the main/sub-main earthing conductor, or its distribution board or to an earth leakage circuit breaker.

d) Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing, Switches, accessories, lighting fitting etc shall be effectively connected to the Loop Earthing Conductors. These though rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered earthed, even though the run of metallic conduit is earthed.

e) No joints shall be allowed in the protective conductors. The same must be directly terminated at metallic switch board / distribution boxes.

f) All terminations shall be made on studs/earth terminal blocks with the use of terminating lugs and double check nuts of appropriate sizes.

EARTHING CONDUCTOR INSTALLATION

The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size. Joints shall be revetted and brazed in approved manner.
Sweated lugs of adequate capacity and size shall be used for termination. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned.

**SIZING OF EARTHING CONDUCTORS**

All fixtures, outlet boxes and junction boxes shall be earthed with 14 SWG copper/ 12 SWG GI wire.

All 3 phase switches and distribution boards up to 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper/6 mm dia GI wires. All 3 phase switches and distribution boards up to 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper/8 mm dia GI wires. All switches, bus bar, ducts and distribution boards of rating 200 amps and above shall be earthed with a minimum of 2 Nos. separate and independent 25 mm x 3 mm copper/25mm x 6 mm GI tape.

**7.0 PROHIBITED CONNECTIONS**

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system.

**8.0 RESISTANCE TO EARTH**

No earth electrode shall have a greater ohmic resistance than 1 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 5 ohms. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuses or circuit breakers, and shall not exceed 1 ohm.

**I) LIGHTNING PROTECTION SYSTEM**

**1.0 STANDARDS**

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of the Contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date shall apply. Wherever appropriate Indian Standards are not available relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

- Code of Practice for the Protection of buildings and Allied Structures against Lightning IS 2309 : 1989
- Code of Practice for Earthing IS 3043: 1987
2.0 GENERAL

The Lightning Protective System shall comprise of Air Terminations, Down Conductors, Earth Terminations etc as required. The System shall preferably use the same conducting material throughout and will comply to the detailed specifications detailed hereinafter. The entire lightning system should be mechanically strong to withstand the mechanical forces produced in case of a lightning stroke.

3.0 MATERIALS

The materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the Schedule of Quantities and shall comply to the following requirements:

- Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian Standard Specifications.

- Galvanised Steel - Galvanised steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309:1968.

- The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

4.0 AIR TERMINATIONS

4.1 Vertical Air Terminations

Vertical air terminations shall comprise of finials made of 25 mm dia GI tube with single or multiple prongs at the top. Vertical terminations where provided shall project 30 cms above the project salient point or net work on which it is fixed.

4.2 Horizontal Air Terminations

Horizontal air terminations should be so interconnected that no part of the roof is more than 9 m away from the nearest horizontal conductor. For a flat roof horizontal air termination along the outer perimeter of the roof is to be used. For a roof of larger area a net work of parallel horizontal conductors shall be installed. Horizontal air terminations should be coursed along contours such as ridges, parapets and edges of the flat roofs and where necessary over flat surfaces in such a way as to join each air termination to the rest and should themselves form a closed network.

All metallic finials, chimneys, duct, vent pipes, railings, gutters, and the like on or above the main surface of the roof of the structure should be bonded to and form part of the air termination network.
5.0 DOWN CONDUCTORS

The Down Conductors shall be of material as specified in the Schedule of Quantities. These shall be distributed around the outside walls of the structure and shall preferable be run along the corners and other projections. Lift shafts shall not be used for fixing the Down Conductors.

The routing of the Down Conductors shall be such that it is accessible for inspection, testing and maintenance.

6.0 TESTING JOINTS AND BENDS

The lightning protective system should have as few joints in it as possible.

Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective.

In the down conductor below ground level there shall be no joints.

The joints may be clamped, screwed, bolted, rivetted, sweated braced or welded. Bolted joints should be used on test points or on bonds to existing metal. Each down conductor should be provided with a testing joint in a position convenient for testing but inaccessible for interference.

7.0 FASTENERS

Conductors shall be securely attached to the building by fasteners which shall be substantial in construction, not subject to breakage.

These shall be of galvanised steel or other suitable materials with suitable precautions to avoid corrosion.

The method and nature of the fixing should be simple, solid and permanent. The lightning conductors shall be secured at not more than 1.20 m apart for horizontal run and 1.00 m for vertical run.

8.0 EARTH TERMINATION

Each down conductor shall have an independent earth termination and all earth terminations should be interconnected.

9.0 EARTH ELECTRODES

Earth electrodes shall be constructed and installed as laid down in the IS 3043.
9.1 Plate Earth Electrode

The plate electrodes shall be of Copper or G.I. as called for in the Bill of Quantities. The minimum dimensions of the electrode shall be G.I. 600 mm x 600 mm x 6 m thick and for Copper 600mm x 600mm x 3mm.

The electrode shall be buried in ground with its face vertical and top not less than 3 m below ground level.

9.2 Earth Electrode Pit

In the case of plate earth electrode, a watering pipe of 20 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300 mm. A cast iron/M.S. frame with cover having locking arrangement shall be suitably embedded in the masonry enclosure.

9.3 Location Of Earth Electrode

The following guidelines shall be followed for locating the earth electrodes

- An earth electrode shall not be situated less than 2 metres from any building.

- The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.

- The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.

- Entrances, pavements and road ways shall not be used for locating the earth electrode.

10.0 EARTH RESISTANCE

The whole of the lightning protective system should have a combined resistance to earth not exceeding 1.0 ohms before any bonding has been effected to metal or on a surface or to surface below ground.

J) H.V. CABLES:

1.0 GENERAL :

The cables shall be supplied, inspected, laid, tested and commissioned in accordance with Drawings. Specifications, Indian Standard Specifications as per latest IS and cable manufacturers instructions. The cables shall be of reputed make.

The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed. The installation of cables shall be done by an approved, qualified and experienced person in this trade.
2.0 MATERIAL:

The H.V. cables shall be 11 KV, aluminium conductor CROSS LINKED POLY-ETHYLENE steel tape armoured cable laid underground and or in masonry trenches as shown on Drawings. The conductor shall be made of Electrical purity aluminium wires and stranded together and compacted. The cable shall be of 3 Core type. The insulation shall be of high quality cross linked polyethylene applied by extrusion process. Both conductor and the insulator are provided with shielding made of Semi Conducting compound. Armouring is applied over inner sheath and shall be of flat steel strips. The outer sheath shall be of heat resisting tropodur (PVC) compound. This shall be of black colour.

3.0 INSPECTION:

All cables shall be inspected upon receipt at site and checked for any damage during transit.

4.0 JOINTS IN CABLES:

The contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoidance of jointing cable. This apportioning shall be got approved by the Owner/ Consultant before the cables are cut to lengths. Where joints are unavoidable, the location of such joints shall be got approved by the Owner/ Consultants.

5.0 JOINTING BOXES FOR CABLES:

Cable joint boxes shall be of appropriate size, suitable for aluminium conductor XLPE insulated cables of 11000 volts ratings, and shall be manufactured by CCI & Indian Cable Corporation or approved equal.

6.0 JOINTING CABLES:

All cable joints shall be made in suitable, approved cable joint boxes. Jointing of cables in the joint boxes and the filling in of compound shall be done in accordance with the best practice in trade, in accordance with manufacturer's instructions and in an approved manner. All straight T-joints shall be done in epoxy mould boxes with TROPOLIN/M-SEAL epoxy resin or approved equal. All jointing accessories shall also be manufactured by Indian Cable Corporation/ CCI or approved equal. All terminal ends of conductors shall be heavily soldered upto atleast 50mm length.

All cables shall be jointed colour to colour and tested for continuity and insulation resistance before jointing commences. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection for the weather shall be arranged. Joints shall be made by means of suitable solder for conductors, the conductors being firmly butted into the connections or thimbles or ferrules and the whole soldered with proper solder and soldering flux or resin. The conductors shall be efficiently insulated with high voltage insulating tape and use of spreaders of approved size and pattern. The joints shall be completely filled with epoxy compound being topped as necessary to ensure that the box is properly filled.
7.0 CABLE TERMINATIONS:

Cable termination shall be done in terminal cable box using cable glands and the cable ends sealed with sealing compound. The cable boxes of transformers shall be filled with bituminous compound manufactured by CCI or approved equal.

8.0 BONDING OF CABLES:

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armoured clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that in the event of ground movement no undue stress is passed into the cable conductors.

9.0 LAYING OF CABLES:

H.V. cables shall be laid either buried directly underground or in Masonry/Concrete trenches. The cable buried underground shall be at minimum depth of 1.2 mtr from the ground level. Sand cushion of not less than 80mm shall be provided both above and below the cable with a protective concrete slab on the top of the sand layer. The cable trench shall be back filled and compacted.

10.0 PROTECTION OF CABLES:

The cable shall be protected by placing precast reinforced 50mm, thick (1:2:4) concrete slabs 200mm wide on the top layer of sand for the length of the cable. Where more than one cable is running in the same trench, the concrete blocks shall cover all the cables and shall project minimum 80mm on either side of the cables.

Cables under road crossings and any surfaces subjected to heavy traffic, shall be protected by running them through Hume pipes of suitable size.

11.0 EXCAVATIONS AND BACK FILL:

All excavations and back fill including timbering, shorting and pumping required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layers not exceeding 150 mm. Each layer shall be properly rammed and consolidated before laying the next layer. The contractor shall restore all surfaces, roadways, side walks curbs, walls or other works cut by excavation to their original condition, satisfactory to the Owner/Consultants.

12.0 MARKERS AND WARNING PLATES:

Approved C.I. cable markers shall be provided along the route of the cable at every 30 M Distance and at both ends of road crossing, indicating H.V. cables. Special C.I. markers shall be provided at all buried cable joints indicating Electrical cable joint.
13.0 TESTING OF CABLES:

Prior to burying cables, following tests shall be carried out:

a) Insulation between phases and between phase and earth for each length of cables, before and after jointing.

b) For H.V. cables, high voltage test by applying 17.5KV DC voltage for 15 minutes for each core and earth.

On completion of cable laying work, the following tests shall be conducted in the presence of the Owner/Consultants.

a) Insulation Resistance Test (sectional and overall)
b) Continuity resistance test.

c) Sheathing continuity test.

d) Earth test.

All tests shall be carried out in accordance with relevant Indian standard code of practice and Electricity Rules. The contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests.

K) BUS DUCT:

1.0 SCOPE

This specification covers the technical requirements of Design, manufacture, test at works, supply of 415V, LT Bus bar trunking.

2.0 STANDARDS

The equipment covered by this specification shall unless otherwise stated, be designed, constructed and tested in accordance with the latest revisions of relevant International standards

3.0 GENERAL

Metal enclosed, Low impedance, air insulated type aluminum conductors Bus bars. Bus bar trunking system shall have nominal current rating up to 4000 Amp, and shall be supplied for the Sub Distribution of Electrical energy.

Bus bar trunking shall have provision for plugging of tap off boxes into the live busbar and designed for feeding to industrial machines and equipment supply.

These systems shall be installed at building truss level and fixed to the lower beams of the roof structure.

The supply of support materials like clamps, steel channel etc., shall also be included in the scope of this tender.
Bus bar trunking enclosure shall be dust and vermin proof, rectangular in cross section and shall be fabricated out of 1.5 mm thick GI sheet. It shall be rigid and robust in construction and shall be treated to prevent any possibility of corrosion. Joints in the enclosure shall be bolted and shall be provided with neoprene gaskets. All retaining catches, screws, bolts and nuts etc. Bus bar trunking shall be manufactured in standard lengths of 3.0 Mts. With arrangements for 2 to 3 tap off in 3 meter length.

4.0 BUSBAR SYSTEM

The BusBar systems shall be produced and tested as “type-tested Switchgear combinations” (TCS), and shall be equipped with fully covered connectors having at least four poles for plug-in tap off boxes.

The Busbars shall be Air Insulated type and made up of Aluminum. The Busbars shall have a continuous current rating as mentioned in Particular Specification and shall have fault withstand capacity of 36 kA/ 1Sec(rms) to 150 kA/ 1sec (rms) for 1 Sec depending on the current rating of bus bar.

The Bus Bar surface shall be tinned, with the contact and butt connection points silver plated. The individual conductors shall have a high quality, heat-resistant insulation rated for conductor.

In their functional position, they shall be horizontally pluggable, on edge or flat, and in each position they shall be operable at continuous nominal current and at an ambient temperature of 40°C the type of protection shall be upto IP44/66 with accessories.

The cross section of neutral conductor should be same us phase conductor.

INSULATION

The Bus bar should be insulated by glass reinforced polyester, B class insulation and Mylar tape throughout its entire length except tap off points

4.1 Feeding System

All busbar systems shall be equipped with a central, or end feeder cabinet for suitably rated ACB.

Necessary extension chambers for easy terminations of incoming cable shall also be provided.

4.2 Expansion Joints

The bus bar systems shall be equipped with standard expansion joints or with expansion bolts in each unit length to compensate thermal elongation of the busbars. As far as local conditions permit, the longest busbar unit lengths shall be used to minimize electrical losses at the butt or bolted connections of the busbars.

4.3 Accessories
All suspension fixings shall be fully tested and approved exclusively as suitable for the installation with particular regard to ambient temperature, environment and loading. The bus system shall be assembled from standard approved components completed at the factory and suitable for the application. Fully certified fireproof bulkheads shall be incorporated within horizontal and vertical section direction changes and where the system penetrates fire rated sections of the building.

5.0 EARTHING

Bus bar trunking enclosure shall be earthed by a continuous copper / aluminium earth bar as mentioned in BOQ, running on the out side of the enclosure throughout the entire length of the Bus bar trunking.

Earth connection shall be brought to the end feed box to form connection to the 5 core incoming cable.

6.0 TESTS

Bus bar trunking shall be completely assembled, adjusted and tested for operation under stimulated conditions to ensure proper functioning of all equipments.

6.1 TYPE TESTS

The Bidder shall furnish two (2) sets of type test certificates for all the tests conducted on similar equipment.

1. Short time current test.

2. Temperature Rise Test

6.2 Routine Tests

1. Mechanical operation test

2. Dielectric tests

6.3 Drawings and Documents

The following drawings and documents shall be furnished in six (6) copies within (3) three weeks of receipt of order.

a. General arrangement drawing of the bus bar trunking showing,

   1. Overall Dimensions for Different rating.
   2. Terminal locations.
   3. Total weight / meter.
   4. Sectional views.
   5. Fixing details.
   6. Sectional view of Tap Off Box.
b. Single Line Diagram.
c. Technical details for Fuse switches.
d. Manufacturing schedule and test schedule.
e. Calculation for busbar sizing.
DETAILED TECHNICAL SPECIFICATION:–
PLUMBING WORKS
### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Clause No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>Plumbing / Sanitary Works</td>
</tr>
<tr>
<td>B)</td>
<td>Sanitary Fixtures &amp; C.P. Fittings</td>
</tr>
<tr>
<td>C)</td>
<td>Water Supply</td>
</tr>
<tr>
<td>D)</td>
<td>Internal Drainage: (Soil, Waste, Vent and Rain Water Pipes)</td>
</tr>
<tr>
<td>E)</td>
<td>External Drainage System: (Sewerage &amp; Storm Water)</td>
</tr>
<tr>
<td>F)</td>
<td>Rain Water Harvesting</td>
</tr>
</tbody>
</table>
A) PLUMBING/SANITARY WORKS:

1.0 GENERAL:

1.1 The work shall be carried out in the accordance with the drawings and design as would be issued to the Contractor by the Design Consultant duly signed and stamped by him. The Contractor shall not take cognizance of any drawings, designs, specifications etc. not bearing Design Consultant signature and stamp. Similarly the Contractor shall not take cognizance of instructions given by any other Authority except the instructions given by the Client’s Representative in writing.

1.2 The work shall be executed and measured as per metric dimensions given in the Bill of Quantities, drawings etc.

1.3 The Contractor shall acquaint himself fully with the partial provisions for supports that may or may not be available in the structure and if are available then utilize them to the extent possible. In any case the Contractor shall provide all the supports regardless of provisions that they have been already made. Nothing extra shall be payable for situations where insert plates (for supports) are not available or are not useful.

1.4 Shop coats of paint that may be damaged during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with paint to match the finish over the adjoining shop painted surface.

1.5 The Contractor shall protect / handle the material carefully and if any damage occure while handling by the Contractor then the sole responsibility shall be of the Contractor. Such damages shall be rectified/recovered by the Contractor at no extra cost whatsoever.

1.6 The Contractor shall, within twenty one (21) days of receipt of the Notice of Award for the Project, where applicable, complete the submission of shop drawings to the Client’s Representative for approval by the Design Consultants in order to conform to the contract schedule.

1.7 Measurements:

All measurements shall be taken in accordance with relevant IS codes, unless otherwise specified.

2.0 APPLICABLE CODES AND STANDARDS:

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practice given below as amended upto the date of submission of Tender. All equipment and material being supplied shall meet the requirements of BIS and other relevant standard and codes.
Plumbing Works:

Vitreous Chinaware

I) IS:2556 - 1974 (Part -
II) IS:2556 - 1981 (Part -
III) IS:2556 - 2556 (Part -

Ball Valve - IS:1703 - 1977
Cistern Brackets - IS: 775 - 1970
Toilet Seat Cover - IS:2548 - 1983
Vitreous China Cistern - IS:2326 - 1987
Sand Cast Iron Pipes and Fittings - IS:1729 - 1979
Spun Cast Iron Pipes and Fittings - IS:3989 - 1984
GI Pipes - IS:1239 - 1979
Galvanising for GI Pipes - IS:4736 - 1986
Pipe Threads - IS: 554 - 1985
Milleable Iron Fittings - IS:1879 - 1987
Cast Iron Sluice Valves - IS: 780 - 1984
Full Way Valves - IS: 778 - 1984
Brass Ferrule - IS:2692 - 1978
Stone Ware Gully Trap - IS: 651 - 1980
RCC Pipes - IS: 458 - 1971
Cast Iron Class LA Pipes - IS:1536 - 1989
Cast (Spun) Iron Fittings - IS:1538 - 1976
Pig Lead - IS: 782 - 1966
Induction Motors - IS:4691
Code for Measurements - IS:1200
UPVC Pipes and Fittings - IS:4984
Specification for Caulking Lead - IS:782
Code of Practice for laying of concrete - IS:783

3.0 QUALITY ASSURANCE AND QUALITY CONTROL:

3.1 The work shall conform to high standard of design and workmanship, shall be structurally sound and aesthetically pleasing. Quality standards prescribed shall form the backbone for the quality assurance and quality control system.

3.2 At the site, the Contractor shall arrange the materials and their stacking/ storage in appropriate manner to ensure the quality. Contractor shall provide equipment and manpower to test continuously the quality of material, assemblies etc. as directed by the Client’s Representative. The test shall be conducted continuously and the result of tests maintained. In addition the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of surface.

3.3 The Client’s Representative shall be free to carry out such tests as may be decided by him at this sole direction, from time to time, in addition to those specified in this Document. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples or for the collection of the samples.
3.4 The test shall be conducted at Standard Laboratory selected by Client’s Representative. Contractor shall keep the necessary testing equipment such as hydraulic testing machine, smoke testing machine, gauges and other necessary equipment required.

3.5 The Client’s Representative shall transport the samples to the laboratory.

3.6 Testing charges shall be borne by the Client’s Representative.

3.7 Testing may be witnessed by the Contractor or his Authorised Representative. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.

B) SANITARY FIXTURES & C.P. FITTINGS:

4.0 SCOPE:

4.1 Work under this section shall consist of transportation, furnishing, installation, testing and commissioning and all labour as necessary as required to completely install all sanitary fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Bill of Quantities.

4.2 General Requirements

4.2.1 All fixtures and fittings shall be fixed with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Bill of Quantities, specifications, drawings or not.

4.2.2 All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural designe requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.

4.2.3 Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required as per directions of Client’s Representative.

4.2.4 All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shows on the drawings and in accordance with the manufacturers 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, wall or ceiling surfaces shall be made good at Contractors cost.

4.2.5 All fixtures of the similar materials shall be by the same manufacturers.

4.2.6 All fittings shall be of the chromium plated materials.

4.3 Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.
4.4 Whether specifically mentioned or not all fixtures and appliances shall be provided with approved fixing devices, nuts, bolts, screws, hangers as required. These supports shall have the necessary adjustment to allow for irregularities in the building area construction.

4.5 For the installation of the CP fittings, teflon tape shall be used.

4.6 EUROPEAN W.C:

4.6.1 European W.C. of glazed vitreous china shall be wash down, single or double siphonic type, floor or wall mounted set, flushed by means of flush valve as specified in Bill of Quantities. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adopter. Wall hung W.C. shall be supported by C.I. floor mounted chair.

4.6.2 Each W.C. seat cover shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Seat cover shall be of white solid plastic, elongated open front with heavy duty hinges. Exposed fixture trims shall be Chrome plated, and trims of similar function shall be by the same manufacturer.

4.6.3 Flush valves shall be of the best approved quality procurable with C.P. control valve and C.P. flush pipe.

4.6.4 The flush pipe/bend shall be connected to the WC by means of a suitable rubber adopter.

4.6.5 Alternatively if flushing cistern to be used shall conform to the requirements of IS:774-1971. High level cisterns shall be of cast iron unless otherwise specified. Low level cistern shall be of the same material as the water closet or as instructed by the Owner/Architect/Consultant. The cisterns shall be mosquito proof & shall fulfill the requirements of the local Authority.

4.6.6 The levels of the WC should be checked by placing spirit level on the W.C. W.C. should be tested on completion of fixing by putting small paper balls and flushing out. If all the paper balls are not flushed out. The fixing will have to be rectified / re-aligned.

4.7 KITCHEN / PANTRY SINKS:

4.7.1 Sinks shall be of stainless steel material as specified in the Bill of Quantities/Drawings.

4.7.2 Each sink shall be provided with R. S. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia Chromium Plated waste with chain and plug or P.V.C. waste with Escutcheon plates. Fixing shall be done as directed by Client’s Representative.

4.7.3 Supply fittings for sinks shall be mixing fittings or C.P. taps, angle cocks etc. all as specified in the Bill of Quantities/Drawings.
4.8 WASH BASINS:

4.8.1 Wash basin shall be of white vitreous china of best quality manufactured by an approved firm and sizes as specified in the Bill of Quantities.

4.8.2 Wash basin shall be of under counter drop in type shall be supported on a pair of rolled steel brackets of approved design and shall be mounted on a countertop. So that rim and basin bowl is exposed from top.

4.8.3 Wash basin shall be provided with single lever mixer with chain and rubber plug, chromium plated brass bottle trap of approved quality, design and make where hot water required. Single tap where hot water is not required.

4.8.4 Wash basin shall be fixed at proper location and height and truly horizontal as shown on drawing or as directed by Client’s Representative.

4.9 HOSE BIBB’S:

4.9.1 Hose Bib of Chromium Plate tap is draw off tap with horizontal inlet and free outlet knurling on outer face to fix the hose pipe. Hose bib shall be of specified size and shall be of screw down type and shall conform to IS:781-1984. The closing device shall work by means of a disc carrying a renewable non-metalic washer which shuts against the water pressure on a seating at right angle to the axis of the threaded spindle which operate it. The handle shall be either crutch or butterfly type securely.

4.10 URINALS:

Half stall wall hung urinals of glazed vitreous china shall be provided with 15mm dia, C.P. brass spreader, 32mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange and shall fixed to wall by one C.I. bracket and two C.I. clips as recommended by manufacturers complete as directed by the Client’s Representative. Urinals shall be flushed by means of “NO-TOUCH” infrared operated flush valves. Waste pipes for urinals shall be any one of the given material as directed by the Client’s Representative:

a) G.I. Pipes
b) Rigid PVC/High density polyethylene.

Waste pipes may be exposed on wall or concealed in chase as directed by the Client’s Representative.

4.11 BATH TUB:

Bath tub & panel shall be white enameled cast iron or pressed steel as specified in the Bill of Quantities of guaranteed quality and specifications.

Each bath tub shall be provided with 40mm dia CP brass waste with 32mm C.P. brass overflow, 40mm dia cast brass overflow-cum-waste trap with pop-up waste assembly. Bath tub shall be provided with four Nos. C.P. brass concealed stop cocks, bath spout and overhead shower or as specified in the Bill of Quantities.
Alimco Township Village Hora Bangar, Kanpur (UP)

Bath tubs shall be fixed true to level firmly fixed to another or supports provided by the manufacturer. Edges touching the wall shall be slightly recessed in the wall finishing so as to ensure water tightness. The fixing shall be perfectly done so that the wall behind does not tend to get damp or patchy.

Contractor shall during the entire period of installation and afterwards protect the bathtub by providing suitable cover or any other protection so as to absolutely prevent any damage to the bathtub until handing over.

4.12 SHOWER SET IN STAFF LOCKERS:

Shower set shall comprises of two C.P. brass concealed stop cocks. Hot and cold water mixing shall be manually by means of concealed stop cocks. One overhead shower with shower arm.

Each shower set shall provide C.P. shower arm with wall flange and shower head of approved quality as specified in the Bill of Quantities.

Concealed stop cocks shall be as fixed as to keep the wall flange clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

4.13 MEASUREMENTS:

4.13.1 Rate for providing and fixing of sanitary fixtures, accessories, urinal partitions shall include all items and operations stated in the respective specifications and Bill of Quantities, and nothing extra is payable.

4.13.2 Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangement required.

C) WATER SUPPLY:

5.0 SCOPE:

5.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the bill of quantities.

5.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

i. Pipe protection & painting.

ii. Connections to all plumbing fixtures, tanks, pumps etc.

iii. Providing hot water pipe lines and supply point with isolation valves, wherever required.

iv. Control valves, masonry chambers and other appurtenances.
v. Connections to all plumbing fixtures, tanks and appliances.

vi. Excavation and refilling of pipe trenches, wherever necessary.

vii. Internal galvanized water supply piping inside the toilets shaft/plant room/terrace.

viii. Testing all line and fixtures as specified.

**5.2 GENERAL REQUIREMENTS:**

5.2.1 All materials shall be new of the best quality and shall be furnished, delivered, erected, connected and finished in every detail conforming to specifications and subject to the approval of Client’s Representative.

5.2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

5.2.3 Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

As far as possible all bends shall be formed by means of hydraulic pipe bending machine for pipes upto 65mm dia.

5.2.4 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. and shall be selected and arranged so as to fit properly into the allocated building space.

5.2.5 Pipes shall be securely fixed to walls by suitable clamps at intervals specified.

5.2.6 Valves and other appurtenances shall be located to provide easy accessibility for operation, maintenance and repairs.

5.2.7 Connection between dissimilar materials.

5.2.8 All G.I. pipes jointing shall be with white lead and spun yarn.

5.2.9 Drawings illustrating block out and penetration of pipes in the wall/floor/slab.

5.2.10 **Unions:** Contractor shall provide adequate no. of unions on all pipes to enable dismantling later and for servicing. Union shall be provided near each gunmetal valves.
5.3 INTERNAL WORKS:

5.3.1 Materials (CPVC pipes, fittings & valves):

5.3.1.1 All pipes inside the buildings and where specified, outside the building shall be CPVC pipes tubes conforming to Specific Gravity ASTM D 792 at 23oC should be 1.55 as specified. With Tensile Strength as per ASTM D 638 at 23oC should be 55 N/mm².

5.3.1.2 All special fittings and accessories like internally or externally threaded brass adaptors, ball valves, globe valves, unions, diaphragm valves, butterfly valves, etc. shall be made of CPVC by Licensee.

5.3.1.3 The CPVC solvent cement used for installing CPVC piping systems shall conform to ASTM F493. Pipes from ½” up to 2” pipes and fittings, single step medium bodied CPVC solvent cement should be used. For CPVC pipes and fittings upwards of 2”, a primer shall be used followed by heavy bodied solvent cement conforming to ASTM F493. PVC solvent cement should not be used.

5.3.2 Concealed Piping

All internal concealed plumbing for water supply shall be done with CPVC. The pipes & fittings shall conform to CTS (copper tube size) SDR-11 as per ASTM D2846 or SDR-13.5. All pipes and fittings from ½” up to 2” shall come under this category. Medium body CPVC solvent cement conforming to ASTM F493 should be used for joining pipes to fittings.

5.3.3 External Piping:

All external plumbing for water supply and distribution shall be done with CPVC pipes. The CPVC pipes above 2” for external water supply lines shall conform to ASTM F441 CPVC Schedule 40 & 80 pipe and will be the CPVC brand. The fittings above 2” size shall conform to ASTM F438 (Schedule 40 CPVC fittings) or ASTM F 439 (Schedule 80 CPVC fittings). All threaded CPVC fittings shall conform to ASTM F437 (threaded CPVC fittings schedule). Heavy bodied CPVC solvent cement shall be used along with a primer. IPS brand primer and heavy bodied CPVC solvent cement only should be used conforming to ASTM F493. All external CPVC pipes shall be coated with water based acrylic paint emulsion for enhanced UV protection.

5.3.4 Installation procedure:

All parameters pertaining to the installation of CPVC plumbing system such as cutting, joining, support spacing, expansion loops, insulation, type of support, special connections, etc. shall be as per the manufacturer’s specifications.

5.3.5 All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets.

5.3.6 Clamps

CPVC Pipes in shafts and other locations shall be supported by galvanized M.S. clamps of design approved by Project Manager. Pipes in wall chases shall be anchored by G.I. hooks.
Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural. Pipes in typical shafts shall be supported on slotted angles/channels as per standard drawings.

5.3.7 Spacing of clamps, hooks etc. shall be as per good engineering practice approved by the Project Manager.

5.3.8 Unions
Contractor shall provide adequate number of unions on pipes 50 mm and below to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Project Manager.

5.3.9 Testing:
After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permitted. The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm which ever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

5.4 Measurements:
The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include CPVC pipe and CPVC fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions etc.. Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Bill of Quantities.

5.5 VALVES:

5.5.1 Butterfly Valves:
All the isolation valve 50cm and above on the equipment and water lines, where specified or shown on drawings shall be wafer type butterfly valves. They shall be designed to fit without gaskets, the water tight seal being obtained by EPDM seat projection at the faces compressed between the flanges. The valves shall be supplied inclusive of M.S. pipe flanges and high tensile steel bolts of dimensions recommended by.
5.5.2 Installation:

Valve shall be install in a manner that allows future removal and service of the valve. Packing and gasket shall not contain asbestos.

The valve shall be of the same size as the pipe to which they are install. Valve above 150mm diameter shall be self locking warm gear type water proof and protory lubricated.

Provide chain operators with chain cleats for all valves more than 2.4 meter above floor.

5.5.3 Non Return Valves:

All non-return valves shall be provided as shown in the drawings conforming to relevant Indian Standards and in accordance with the following specifications.

<table>
<thead>
<tr>
<th>Size</th>
<th>Construction</th>
<th>Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 50 mm.</td>
<td>Gun metal</td>
<td>Screwed</td>
</tr>
<tr>
<td>65 mm and above</td>
<td>Gun metal/cast iron</td>
<td>Flanged</td>
</tr>
</tbody>
</table>

Non-return valves shall be of approved make. Flap type non-return valve shall be used and tested to 15 Kg/Sq.cm. pressure.

5.5.4 Ball Valves (Float Valve):

The ball valve shall be of high pressure class and shall be confirm to IS:1703 of sizes as specified. The nominal size of a ball valve shall be that corresponding to the size of the pipe to which it is fixed. The ball shall be of brass or gun metal as specified and the float shall be of polythene sheet. The minimum gauge of copper sheet used for making the float shall be 0.45mm for float upto 115mm dia and 0.55mm for float exceeding 115mm dia and shall be special in shape. The valve shall be constructed to permit replacing without console of the valve body from the valve line and the system shall not blow out under pressure. The jointing of the float shall be made by efficiently burnished, lapped and soldered seam or by bracing. Plastic float may also be used if specified. The body of ball valve when assembled in working conditions with the float immersed to not more than half of it’s volume shall remain closed against a test pressure of 10.5 Kg/Sq.cm. All ball valves shall be capable of withstanding a pressure of 14 Kg/Sq.cm.

The ball valve shall generally conform to IS specifications No. 1703-1962.

5.5.5 Ball Valves:

The ball valve shall be of Brass or Gunmetal as specified conforming to IS:1703. The ball valve shall be as given below:

5.5.6 Air Valves:

Air valves shall be provided in all high points in the system to prevent air locks as shown on the drawings or directed by Client’s Representatives.
5.5.7 Testing:

All valves shall be tested while installed in pipe by hydrostatic pressure of 1.5 time of the working pressure 7.5 Kg/Sq.cm which ever is more.

5.5.8 Measurements:

All valves as mentioned in Bill of Quantities shall be measured by numbers and shall include all items mentioned in the Bill of Quantities.

5.6 CHLORINATION OF DOMESTIC WATER LINES:

5.6.1 After the completion of all the hot and cold water service piping, disinfect all the fresh water supply work and water reservoirs using a chlorine solution.

5.6.2 Chlorinated Systems Shall Include:

i. Domestic fresh water tanks
ii. Fire water tanks
iii. All pipe work systems receiving suction from the above mentioned tanks apart from the fire systems.

5.6.3 Before handover of the system, submit to the consultant copies of the certification of performance and laboratory report (if required)

5.6.4 Under no circumstances the use of any portion of the fresh water system until it is properly disinfected, flushed and certified shall be permitted.

5.6.5 During the Chlorination work the Contractor shall take all necessary precautions to prevent site staff from drinking the system water. Such precautions shall include looking doors to ‘wet’ areas and providing warning signs in English and Hindi.

D) INTERNAL DRAINAGE : (SOIL, WASTE, VENT AND RAIN WATER PIPES)

6.0 SCOPE:

6.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter and given in the Bill of Quantities.

6.1.2 Without restricting to the generality of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:-

i. Cast Iron horizontal and UPVC vertical soil, waste and vent pipes, rainwater pipes and fittings, joints clamps and connections to fixtures.

ii. Floor traps, floor drain clean out plugs, inlet fittings and rainwater roof drain, area/local drains, trench drain.
iii. Waste pipes connections from all fixtures e.g. Wash basins, sinks, kitchen equipment.

iv. Testing of all pipes.

v. Connection of main.

6.2 GENERAL REQUIREMENTS

6.2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Client’s Representative.

6.2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

6.2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

6.2.4 Pipes shall be securely fixed to walls by suitable clamps at intervals specified.

6.2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

6.2.6 All works shall be executed as directed by Client’s Representative.

6.3 CAST IRON PIPES & FITTINGS

6.3.1 Soil, waste, vent and anti-siphonage pipes shall be cast iron pipes with socket and spigot. 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 oil pipes conforming to sand cast I.S. 3989.

6.3.2 Standard weight, dimensions and Drip Seal required for joints shall be as follows:

<table>
<thead>
<tr>
<th>Diameter Depth</th>
<th>Thickness</th>
<th>Overall weight</th>
<th>Internal 6' length diameter of socket lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>5</td>
<td>11.41</td>
<td>76</td>
</tr>
<tr>
<td>75</td>
<td>5</td>
<td>16.52</td>
<td>101</td>
</tr>
<tr>
<td>25</td>
<td>5</td>
<td>21.67</td>
<td>129</td>
</tr>
<tr>
<td>100</td>
<td>5</td>
<td>31.91</td>
<td>181</td>
</tr>
<tr>
<td>25</td>
<td>5</td>
<td>31.91</td>
<td>181</td>
</tr>
<tr>
<td>150</td>
<td>5</td>
<td>31.91</td>
<td>181</td>
</tr>
<tr>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.3.3 Tolerance

Acceptable tolerance for pipes to I.S. 1729 shall be as follows:-

a) Wall thickness  -15%
b) Length ± 20 mm
c) Weight ± 10%

6.3.4 Fittings

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.

Access door shall be secured air and water tight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal.

6.3.5 Jointing:

All soil, waste and vent pipes including fixture connections between traps and soil pipes shall be jointed with refined Drip Seal conforming to IS:27-1977 sufficient sken of jute rope shall be caulked to leave a minimum space for the Drip Seals given in 6.3.2 to be poured in. After pouring the lead shall be caulked into the joint with caulking tool and hammer. All surplus lead shall be cut and joint left flush with the rim of the socket neatly.

6.3.6 Vent pipes penetration through roof shall be by means of sleeves. The sleeve will be kept 100mm higher the finish roof level and annular space filled with fire proof materials like putty, fire seal etc.

6.3.7 Pipes, Hangers, Supports, Clamps, Brackets etc.:

All vertical pipes shall be fixed by M.S. 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).

Inclined pipes running along ceiling shall be fixed on M.S. adjustable hangers of special design shown on the drawings or as directed. Pipes shall be laid to uniform slope and the hangers adjusted to the proper levels so that the pipes fully rest on them.

M.S. clamps shall be of standard design and fabricated from M.S. flat 40mm x 3mm x 3mm thick. They shall be painted with two coats of black bitumen paint before fixing.

Structural clamps shall be fabricated from M.S. structural members e.g. rods, angles, channels, flats, as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding and paint the clamps with one coat of red oxide. Wooden saddles shall be provided free of cost.

Slotted angle/channel supports on walls shall be provided wherever shown on drawings or as required. Angles/channels shall be fixed to brick walls and bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. Holes required in RCC
walls shall be neatly drilled by electric drills and no manual chiseling will be allowed. The spacing of supports horizontally shall not exceed 1.8 M.

Wherever M.S. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and for making good with cement concrete 1:2:4 (mix 1 cement :2 coarse sand :4 stone aggregate 20mm nominal size) as directed by the Client’s Representative.

6.3.8 Testing:

All pipe work shall be tested before connecting any appliances and then again after connection of appliances. Pipe shall be tested after installation by one of the test given below as directed by the Client’s Representative.

Before use at site, all C.I. soil pipes shall be tested by filling up with water for at least 10 minutes at 3 meter head. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours.

Water Test:

Pipes shall be tested after installation by filling up the stack with water. All openings and connections shall be suitable plugged. The total head in the stack shall however not exceed 3 M. The level of water in the stack shall not drop within 8 hours. If there is a drop in level of water the leak shall be detected and rectified and test shall be reconducted until satisfactory result is achieved.

Smoke Test:

Contractor may test all soil and waste stacks by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlet and outlet connections.

The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by the Client’s Representative.

6.3.9 UPVC Pipes and Fittings:

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from grooving and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designated by external diameter and shall conform to IS:4985-1981.

Fittings:

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.
Laying and Jointing:

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring for vertical line. The type of joint shall be used as per site conditions/direction of the Client’s Representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with G.I. adopter for insertion in the R.C.C. slab for a water proof joint complete as directed by Client’s Representative.

Supports:

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

Repairs:

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs should be made by replacement of the damaged section. If any split or chipout occur in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

Testing:

All lengths of PVC rain water pipes shall be fully tested for water tightness by means of water test maintained for not less than 30 minutes. All pipes shall be subjected to a test pressure of at least 1.5 metre head of water head. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

6.3.10 Waste Pipe from Appliances:

i) Waste pipe from appliances e.g. wash basins, sinks, urinals, chrome plate where seen water coolers shall be of galvanised steel (heavy class) conforming to IS:1239- 1979.

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 structural clamps. Spacing for clamps for such pipes shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Vertical</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.I. Pipes</td>
<td>300 cms</td>
<td>240 cms</td>
</tr>
<tr>
<td>P.V.C. Pipes</td>
<td>180 cms</td>
<td>120 cms</td>
</tr>
</tbody>
</table>

6.3.11 Painting

Soil, waste vent and rainwater pipes in exposed location, in shafts and pipe spaces shall be thoroughly cleaned to remove dirt, rust and other contamination, and painted with two or more coats of synthetic enamel paint to give an even shade.

Paint shall be of approved quality and shade, where directed pipes shall be painted in accordance with approved pipe colour code.

Waste pipes in chase shall be thoroughly cleaned to remove dirt, rust and other contamination, and 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.

C.I. soil and waste pipes below ground and covered in cement concrete shall not be painted.

6.3.12 Measurements:

C.I./ UPVC/ G.I. waste/soil, waste, vent and rain water pipes shall be measured over all along the centre line correct to a centimeter including all fittings along its length. The rate for these pipes shall be inclusive of all fittings, holder bat clamps, lead caulked joint for C.I. and cement joints for UPVC and all other items described in the Bill or Quantities. The portion of the pipe within the collar for C.I./UPVC pipe at the joint shall not be included in the length of the pipe work.

6.4 TRAPS:

6.4.1 Nahani Trap or Floor Traps:

Nahani traps or floor traps shall be cast iron, deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:3 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) mixed with water proof compound and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30 x 30 cms of the required depth. The trap shall be installed at lowest point ensure no ponding occurs at perimeters of the drain.
6.5 Floor Trap Inlet

Bathroom traps and connections shall ensure free and silent flow of discharging water. Where specified, the Contractor shall provide a special type galvanised iron inlet fitting without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and fitting shall be connected to a C.I ’P’ or ‘S’ trap with at least 50mm seal (Hopper and traps shall be paid for separately). Floor trap inlet fittings and the trap shall be set in cement concrete blocks.

6.6 C.P./Stainless Steel Gratings

Floor and Urinal traps shall be provided with 100-150mm square or round C.P./Stainless steel grating as approved by Client’s Representative with rim, of approved design and shape. Minimum thickness shall be 4-5mm or as specified in the Bill of Quantities.

6.7 Cleanout Plugs:

Contractor shall provide cast brass cleanout plugs in all horizontal run more than 15 mtr length required one cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a G.I. socket and lead caulked joint.

6.8 Pipe Sleeves:

Pipe sleeves 50mm larger diameter than pipes shall be provided wherever pipes pass through walls and slabs and annular space filled with fire proof materials like putty, fire seal etc. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matters. Vertical sleeve shall finish 50mm above finish floor level.

E) EXTERNAL DRAINAGE SYSTEM (SEWERAGE & STORM WATER):

7.0 SCOPE:

i. Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install the drainage system as required by the drawings and specified hereinafter or given in the Bill of Quantities.

ii. Without restricting to the generality of the foregoing, the drainage system shall include:

- Sewer lines including excavations, pipe lines, man holes, drop connections, underground storm water drains, including pipes, man holes, catch basins and open drains, thrust blocks.
7.1 GENERAL REQUIREMENTS:

All materials shall be new of the best quality conforming to specifications and subject to the approval of the Client’s Representatives.

Drainage lines shall be laid to the required gradients and profiles.

All drainage work shall be done in accordance with the local municipal bye-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority and also existing invert levels required to enter sanitary system.

Location of all manholes, catch basins, etc. shall be confirmed by the Client’s Representatives before the actual execution of work at site.

All excavation, trenches etc shall be barricaded as per instruction of the Client’s Representatives.

All works shall be executed as directed by the Client’s Representatives.

7.2 TRENCHES FOR PIPE & DRAINS:

7.2.1 Alignment and Grade:

The drains are to be laid to alignment and gradients in continuous shown on the drawings but subject to such modifications, as shall be ordered by the Client’s Representative from time to time to meet the requirements of the works. No deviations from the line, depths of cutting or gradients of sewers shown in the plans and sections shall be permitted except by the express direction in writing of the Client’s Representative.

7.2.2 Opening out Trenches:

In excavating the trenches at the road metaling, pavement kerbing etc. are to be placed on one side and preserved for rein statement when the trench or other excavation shall be filled-up.

Before any road metal is replaced, it shall be carefully shifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Client’s Representative. The Contractor shall not cut or break down any live fence or trees in the line of the proposed works but shall tunnel under them unless the Client’s Representative shall order to the contrary.

Trench to be excavated to alignment + depth required. Trench to be properly dressed and de-watered. Trench shall be kept free of water at all time. Discharge of water shall be into nearest drainage channel not on the road.

All underground pipe to be laid open in trench. Pipes to be laid and maintained at required levels and grade during course of work. All joints to be aligned and complete. Trench shall
be of 450mm wide than pipe. Concrete anchors at change in direction for C.I. pipe shall be provided. Pipe shall be rest on cushion in the trench.

The Contractor shall scrub up and clear the surface over the trenches and other excavations of all stumps, roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Client’s Representative.

7.2.3 Construction Across the Roads:

All the pipe line or drain crossing existing road, the road crossing shall be excavated at a time, the second half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measure for traffic as directed shall be adopted. All type of pipes, water mains, cables etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable removal of which is necessary, shall be arranged by the Client’s Representative or the Contractor shall arrange to support and protect them during excavation.

7.2.4 Excavation to be Taken to Proper Depth:

The trenches shall be excavated to such depth and width that the sewers pipe shall rest on cushion so that the inverts may be at the levels given on the section/plan. In bad ground the Client’s Representative may order the Contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewer with such materials as decided by Client’s Representative in writing.

7.2.5 Refilling:

The filling shall be done in layers not exceeding 15mm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of the crow brass where rammers can not be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches.

Filling in trenches shall be commenced soon after the joints of pipes, cables, conduits etc. have been tested and approved by Client’s Representative. The space around the pipes shall be cleared of all debris where the trenches are excavated in hard/soft soil. The filling shall be done with earth on the sides and tops of pipes in layers not exceeding 15mm in depth. Each layer shall be watered rammed and consolidated. The clods and lumps of earth exceeding 8cm in any direction shall be broken or removed before the excavated earth is used for filling. Generally no test is done to determine the instu diversity of filled earth but on the discretion of Client’s Representative the 95 proctor’s compaction test may be done to ensure the in situ density after filling. Consolidation is removal of water from the pores and compaction is the explosion of air from the pores. In case of refilling consolidation places most important role as the watering of the each layer is being done properly. If required by the Client’s Representative proctors needle may also be used for the proper checking of the refilling items of in situ density.
7.2.6 Contractor Shall Restore Settlement and Damages:

The Contractor shall at his own cost make good promptly during the whole period the works are in hand, any settlements that may occur in the surfaces or roads, beams, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations due to not using the method of compaction as given in clause 7.3.5 and he shall be liable for any accidents caused thereby.

He shall also at his own expense and charges, repair and make good any damage done to the building and other properties.

7.2.7 Disposal of Surplus Soil:

The Contractor shall at his own cost and charge, dispose off from the site all surplus excavated material not required to be used on the works.

i. The width of excavated trench shall be as per table given below:

<table>
<thead>
<tr>
<th>Excavation upto</th>
<th>Upto 100 mm</th>
<th>Upto 150 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>dia pipe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 cms depth</td>
<td>33 cms</td>
<td>33 cms</td>
</tr>
<tr>
<td>90 - 150 cms depth</td>
<td>60 cms</td>
<td>60 cms</td>
</tr>
<tr>
<td>150 - 300 cms depth</td>
<td>75 cms</td>
<td>75 cms</td>
</tr>
<tr>
<td>300 - 500 cms depth</td>
<td>90 cms</td>
<td>100 cms</td>
</tr>
</tbody>
</table>

7.2.8 Protection of Existing Services:

All pipes, water mains, cables etc encountered in the course of excavation shall be carefully protected and supported. In case of any damage caused the same shall be made good at no extra cost failing which necessary works will be carried out by the Clients Representative and contract charged to the Contractor.

7.3 RCC PIPES:

7.3.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes NP2 for general and NP3 where road crossing. Pipes shall be true and straight with uniform bore throughout. Cracked, wraped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, prior to use on site, a certificate to that effect from the manufacturer.

The pipes shall be with or without reinforcement as required and of the class as specified. These shall conform to IS:458 - 1971. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process.

All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. The pipes shall be R.C.C. light duty, NP2 and NP3 type.
7.3.2 Laying:

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

7.3.3 Jointing:

(Rigid Spigot and Socket Joint):

Hemp rope soaked in neat cement wash shall be passed round the joint and inserted in it by means of caulking tool. More skein of yarn shall be added and rammed home. Cement mortar with one part of cement and one part of sand and with minimum water content but on no account soft or sloppy, shall be carefully inserted, punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall then be finished off neatly outside the socket at an angle of 45 degree.

7.3.4 Curing:

The joint shall be cured for at least seven days.

7.3.5 Cement Concrete for Pipe Supports:

a) Unless otherwise directed by the Client’s Representative cement concrete for bed, all round or in haunches shall be laid as follows:

<table>
<thead>
<tr>
<th>Type of Pipe</th>
<th>Up to 1.5m depth (5′)</th>
<th>Up to 3m depth (10′)</th>
<th>Beyond 3m depth (10′)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes in open ground (no sub soil water)</td>
<td>all round (1:5:10)</td>
<td>in haunches (1:3:6)</td>
<td>all round (1:5:10)</td>
</tr>
<tr>
<td>RCC/C.I. pipes in sub soil water</td>
<td>all round (1:3:6)</td>
<td>in haunches (1:3:6)</td>
<td>in haunches (1:3:6)</td>
</tr>
<tr>
<td>RCC/C.I. pipes (in all conditions)</td>
<td>all round (1:3:6)</td>
<td>in haunches (1:3:6)</td>
<td>in haunches (1:3:6)</td>
</tr>
<tr>
<td>RCC/C.I. pipes under road or building</td>
<td>all round (1:3:6)</td>
<td>all round (1:3:6)</td>
<td>all round (1:3:6)</td>
</tr>
</tbody>
</table>

b) RCC pipes or CI pipes may be supported on brick masonry or pre-cast RCC or in situ cradles. Cradles shall be as shown on the drawings.

c) Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.
7.3.7 Measurement:
   a) Excavation:

   Measurement for excavation of pipes trenches shall be made per linear meter. b) Trenches
   shall be measurement between outside walls of manholes at top and the depth shall be
   the average depth between the two ends to the nearest cm. The rate quoted shall be for a
   depth upto 1.5 metre or as given in the Bill of Quantities.

   c) RCC pipes shall be measured for the length of the pipe line per linear meter i.e.:

      i. Length between manholes shall be recorded from inside of one manhole to inside of
         other manhole.

      ii. Length between gully trap and manhole shall be recorded between socket of pipe near
          gully trap and inside of manhole.

7.4 Sewer Appurtenances:

Inspection Chambers and Manholes:

i. Size of Chambers/Manholes:

   The size given in Bill of Quantities and drawings shall be internal finished size of chamber. The work
   shall be done strictly as per standard drawing and following specifications.

ii. Bed Concrete:

   Shall be in 1:4:8 cement concrete 200 mm thick).

iii. Brick Work:

   Brick work shall be with best quality bricks in 1:6 cement mortar.

iv. Plaster:

   Inside of the walls of chamber/manhole shall be plastered with 12/15 mm thick cement plaster 1:3
   (1 cement :3 coarse sand) and finished smooth with a floating coat of neat cement. Manholes shall
   be plastered from out side as above but with rough plaster.

   Water proofing compound as approved by the Client’s Representative shall be added in the
   cement sand mortar ratio as specified by manufacturer.
Manhole Covers and Frames:

The covers and frames shall conform to IS:1726-1960 and shall be of the following grades and types:

a) Heavy Duty:

These shall be denoted by the letters ‘HD’ circular solid type for use under heavy vehicular traffic conditions.

b) Medium Duty:

These shall be denoted by the letter ‘MD’ circular or rectangular solid type for use under light traffic conditions such as foot paths, carriage drives and cycle tracks.

c) Light Duty:

These shall be denoted by the letters ‘LD’ or rectangular size for use in domestic premises of where they are not subjected to wheeled traffic loads.

The covers and frames shall be leanly cast and they shall be free from air and sand holes and from cold shuts. They shall be nearly dressed and carefully trimmed. All castings shall be free from voids whether due to shrinkage gas inclusion or other causes. Covers shall have a raised chequered design on the top surface to provide an adequate non-slip grip.

The covers shall be capable of easy opening and closing and it shall be fitted in the frame in workmanship like manner. The cover shall be gas tight and water tight.

The size of covers specified shall be taken as the clear internal dimensions of the frame.

The approximate weights of the various type of manhole covers and frames shall be as in table given below:

<table>
<thead>
<tr>
<th>Description of C.I. Manhole Cover</th>
<th>Weight of Cover Kg.</th>
<th>Weight of Frame Kg.</th>
<th>Total Weight of Cover and Frame Kg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD 560 mm dia LD, rectangular</td>
<td>108</td>
<td>100</td>
<td>208</td>
</tr>
<tr>
<td>455x610mm (single seal)</td>
<td>23</td>
<td>15</td>
<td>38</td>
</tr>
<tr>
<td>MD 500 mm dia</td>
<td>58</td>
<td>58</td>
<td>116</td>
</tr>
</tbody>
</table>

2 ½% variation in weight shall be permissible on either side.
Covers and frames shall be coated with a black bituminous composition. The coating shall be smooth tepacious. It shall not flow when exposed to a temperature of 63 Deg. and shall not be brittle as to chip off temp. of 0 Deg. C.

The frame of manhole cover shall be firmly embedded to correct alignment and levels in RCC slab or plain concrete, as the case may be on the top of the masonry.

After completion of the work, manhole covers shall be sealed by means of thick grease.

vi. Manhole Testing:

The selection of pipe per lot for testing & failure percentage no. of test Concrete mix & curing etc. shall be as per IS: 12592 (Part-I) for Pre-Cast Concrete Manhole Cover & Frame. The load of class AA shall be as per IRC guidelines. The contractor has to design the pre cast RCC cover slab for loading for given concrete mix & get it approved from Engineer. However, the testing to its full satisfaction and as per given criteria is the responsibility of the Contractor. The testing shall be got done through party. The Manhole & Road Side Chamber cover and frame shall be heavy duty & medium duty (tested at 35 T load) respectively in Steel Fibre Reinforced Concrete (SFRC) and confirm to IS 12592 (Part I & II) except for the scraper manhole for which pre cast RCC strips are as shown in drawing.

The precast R.C.C. slab cover shall be tested as follows:

Class AA loading = 6250 kg.
Impact factor = 6250 x 1.25 = 7810 kg.
Test load = 1.25 x 7810 = 9765 kg.

The test load 9765 kg distributed over an area 300 mm x 150 mm is placed at the centre of the slab. The slab is tested under this load deflection recovery test as recommended in clause 17.6.2, 17.6.3, 17.6.3.1 of IS: 456-2000.

The entire height of the manhole shall be tested for water tightness as per CPHEEO Manual, by closing both the incoming and outgoing ends of the sewer and filling the manhole with water and the drop in water level not more than 50 mm per 24 hours shall be permitted. The required water for testing and any other requirements shall be arranged by the Contractor at his own cost. The same procedure shall be adopted for road side chamber for water tightness test.

vii. Foot Rests:

All manholes deeper more than 0.6 m shall be provided with plastic foot rests (Polypropylene is injection moulded around a 12mm dia steel reinforcing bar). These shall be embedded 20cm, deep with 20 x 20 x 10cm blocks of cement concrete 1:2:4 (1 cement :2 coarse sand :4 graded stone aggregate 20cm, nominal size). The block with plastic foot rest placed it’s centre shall be cast in situ along the masonry and surface finished with 12mm thick cement plaster 1:3 (1 cement :3 coarse sand) finished smooth.

viii. All cast iron and Mild Steel items shall be provided with two coats of bitumastic paint.
Measurement:

Manhole shall be measured in numbers as indicated in the Bill of Quantity. The depth of manhole shall be measured from invert of channel to the top of manhole cover. Quoted rate shall cover the range of ± 0.24 metre on the depth specified in schedule and also the cost of items specified in the Bill of Quantities and Specifications viz.

Manhole with depth greater than specified under the main item shall be paid for under “Extra Depth” and shall include all items as given for manholes depth will be measured to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.

i. Bed concrete.
ii. Brick work.
iii. Plastering.
iv. R.C.C. top slab, benching and channeling including drop connections.
v. Supply and fix M.S. foot rests.
vi. Keeping holes and embedding pipes for all the connections.
vii. Excavation, refilling, necessary dewatering and disposing off surplus soil to a place as directed by Client’s Representative.
viii. Curing.
ix. Cost of frame and cast iron cover including reinforcement, angle frame and embedding the frame in concrete bed.
x. Testing.
xi. De-watering of chambers.

Gully Trap:

Gully traps shall be fixed in cement concrete 1:5:10 mix and a brick masonry chamber 30 x 30cms C.I. sealed cover and frame weighting not less than 7.3 Kgs to be constructed as per standard drawings. Where necessary, sealed cover shall be replaced with C.I. grating of the same size (1 cement : 5 coarse sand : 10 stone aggregate : 40mm nominal size).

Measurements:

Gully traps shall be measured by the number and rate which shall include all excavation, foundation, concrete, brick masnory, cement plaster inside and outside, CI grating and sealed cover and frame.

7.5 DROP CONNECTIONS:

7.5.1 In case where branch pipe sewer enters the manhole of main sewer, a drop connection should be provided. H.C.I. pipes and specials conforming to IS:1729-1964 as revised from time to IS:1729-1964 as revised from time to time shall be of the size same as of the branch pipe sewer.

For 150 x 250mm main line, if the difference in level between the water line (peak-flowlevel) and the invert level of branch line is less than 60cm, a drop connection may be provided within the manhole by giving ramp. If the different in level is more than 60 cm the drop should be provided externally.
7.5.2 Excavation:

The excavation shall be done for the drop connection at the place where the branch line meets the manhole. The excavation shall be carried up to the bed concrete of the manhole and to the full width of the branch line.

7.5.3 Laying:

At the ends of branch sewer line Cast Iron tee shall be fixed to the line which shall be extended through wall of the manhole by horizontal piece of Cast Iron pipe form an inspection on cleaning eye, the open end shall be provided with chain and lid. The Cast Iron drop pipe shall be connected to the tee at the top and to Cast Iron bend at the bottom. The end shall be extended through the wall of the manhole by a piece of Cast Iron pipe which shall discharge into the channel. Necessary channel shall be made with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate to 20mm nominal size) and finished smooth to connect the main channel. The joint between Cast Iron pipe to fittings shall be lead caulked. The joint between Cast Iron tee and RCC branch line shall be made with cement mortar 1:1 (1 cement : 1 fine sand). The exposed portion of the drop connection shall be encased around with minimum 15 cm thick concrete 1:3:6 (1 cement : 3 fine sand : 6 graded stone aggregate 40mm nominal size) and cured. For encasing the concrete around the drop connection, necessary centering and shuttering shall be provided.

The holes made in the walls of manholes shall be made good with brick work in cement mortar 1:5 (1 cement : 5 fine sand) and plastered with cement mortar 1:3 (1 cement : 3 coarse sand) on the inside of the manhole wall. The excavated earth shall be back filled in the trench in level with the original ground level.

7.6 Making Connections:

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

7.6.1 Measurements:

Item for making connection to municipal sewer shall be paid for by number and shall include all items given in the Bill of Quantities.

7.7 PUMPS & EQUIPMENTS:

Scope:

This specification covers the design, performance, manufacture, construction features, testing, delivery, installation and commissioning of portable, vertical submersible type drain pumps at pumping station.

Design Requirements:
The pump shall be capable of developing total head at required capacity. The total head capacity curves should be continuously rising towards the shut off with highest at shut off.

The power rating of the motor shall not be less than the power required through out the range of operation.

Construction Features:

Pumps shall be of vertical motor, submersible, single stage with non clog type of impeller with mechanical seal. The bronze impeller shall be mounted on the extended staff of the motor.

Material of Construction:

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casing</td>
<td>IS 210 Gr. FG 260</td>
</tr>
<tr>
<td>Shaft</td>
<td>AISI – 410</td>
</tr>
<tr>
<td>Impeller</td>
<td>S.S. CF 8 M</td>
</tr>
</tbody>
</table>

Inspection & Testing:

The following equipments shall be got inspected by Engineer-in-Charge at works as stated earlier. The acceptance test as per latest relevant IS shall be carried out.

(i) Pumps
(ii) Motor
(iii) Sluice valves
(iv) Reflux valves

F) RAIN WATER HARVESTING:

8.0 General:

8.1 Surface water is inadequate to meet our daily water demand and we have to depend on ground water. Due to rapid urbanization, infiltration of rain water into the sub-soil has decreased drastically and recharging of ground water has diminished. The result of this in decline in water levels in most of the country.

8.1.2 To overcome with the problem mentioned above. The right solution is to use the rain water harvesting techniques.

8.2 Definition of Water Harvesting:

8.2.1 In scientific terms, water harvesting refers to collection and storage of main water and also other activities aimed at harvesting surface and ground water, prevention of losses through evaporation and seepage and all other hydrological studies and engineering interventions, aimed at conservation and efficient utilization of the limited water endowment of physiographic unit such as a water shed.

8.2.2 In general, water harvesting is the activity of direct collection of rain water. The rain water from the roof or from the surface can be directly stored for direct use or can be recharged in the ground water.
8.2.3 Most of the people are not aware that the rain water is the first form of water in the hydrological cycle, hence is a primary source of water for us. The other source like rivers, lakes and groundwater are all secondary source of water. In present times, we depend entirely on such secondary sources of water. In the process, it is forgotten that rain is the ultimate source that feed the water to all the secondary sources and remain ignorant of its value. Water harvesting means to understand the value of rain and to make optimum of rain water at the place where it falls.

8.3 Necessity of Water Harvesting:

8.3.1 In India there is a lot of rain, yet there is no water. The annual rainfall over India is higher compared to the global average rainfall. However, this rainfall occurs during short spells of high intensity. Due to such high intensities and short duration of heavy rain, most of the rain falling on the surface tends to flow away rapidly to these secondary sources as mentioned above, and very little rain water is left for the recharging of the ground water.

8.3.2 It is necessary to implement measures to ensure that rain falling over a region is tapped as much as possible through water harvesting, either by recharging it into the ground water aquifers or storing it for direct use.

8.4 Amount of Water Harvested:

8.4.1 The total amount of water that is received in the form of rainfall over an area is called rain water endowment of the area. Now out of this the amount that can be effectively harvesting is called the water harvesting potential. Water harvesting potential is rainfall (mm) x collection efficiency.

8.4.2 The collection efficiency accounts for the fact that all the rain water falling over an area cannot be effectively harvested because of evaporation, spillage etc. Factor like runoff coefficient and the first flush wastage are taken into account when estimating the collection efficiency.

8.5 Advantages of Rain Water Harvesting:

8.5.1 The advantages by adopting Rain Water Harvesting is as under:

i) Provides self-sufficiency to water supply system.

ii) Reduce the cost for pumping of ground water.

iii) Provides high quality water, soft and low in minerals.

iv) Improves the quality of ground water through dilution when recharged to ground water.

v) Reduces soil erosion in urban areas.

vi) The roof top rain water harvesting is less expensive.

vii) Rain Water harvesting system is simple which can be adopted by individuals.
viii) An ideal solution of water problem in areas having inadequate water resources.

ix) Reduces the runoff which chokes the storm water drains.

**8.6 Method of Rain Water Harvesting:**

8.6.1 The method of rain water harvesting are of two types. One by storage of rain water on surface for future use. Second by recharging to ground water.

8.6.2 The storage of rain water on surface is a traditional technique and structures used were underground tanks, ponds, check dams, weirs etc. and recharge to ground water is a new concept of rain water harvesting and name of few of them are recharge pits, trenches, dug wells, hand pumps, recharge wells, recharge shafts, lateral shaft and borewells shaft with borewells etc.
Alimco Township Village Hora Bangar, Kanpur (UP)

SEWAGE TREATMENT PLANT:

1. INTRODUCTION

In the following sections, the total scheme is given for treatment of sewage, meeting specified discharge norms for reuse for maintaining garden or otherwise, process equipment details, scope of supply and commercial terms and conditions.

A sewage treatment plant in line with present day development based on latest Technology has been proposed.

2. WASTE WATER CHARACTERISTICS

As per the details furnished, the characteristics and the flow is as below which will form the basis for designing the treatment plant:

Domestic Sewerage

<table>
<thead>
<tr>
<th>Raw Sewage Generation &amp; Characteristics for Designing of the plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily flow (cum/day)</td>
</tr>
<tr>
<td>PH</td>
</tr>
<tr>
<td>BOD (5 days at 20 degree C) (mg/l)</td>
</tr>
<tr>
<td>COD</td>
</tr>
<tr>
<td>Suspended solids (mg/l)</td>
</tr>
<tr>
<td>Oil &amp; Grease (mg/l)</td>
</tr>
<tr>
<td>Invert level of sewer</td>
</tr>
</tbody>
</table>

Treated water Characteristics

| BOD                     | < 20mg/l |
| COD                     | < 100mg/l|
| Suspended solids        | < 30 mg/l|
| Oil & Grease            | < 10 mg/l|
| Ph                      | 7-8      |

3. TREATMENT CONCEPT

### The sewage produced first passes through a coarse screen for the removal of large floatables. It then flows to Oil & Grease Trap & from there to Equalization Tank. Air Line is provided in equalization tank to convert the sewage to homogenous mixture & to prevent anaerobic growth of bacteria

### From equalization tank sewage is pumped into aeration tank.

### Here BOD / COD load reduction takes place. In this tank the bacterial culture is developed. There is sufficient incorporation of air by blowers. The bacteria degrade / eat up complex organic
matters from sewage and grow in number and size and become heavier. The mixture of bacterial mass and dissolved organic matter free water is transferred to secondary clarifier/ Tube settler

## Secondary Clarifier is a tank having hopper shaped bottom. The sludge settles in the central pit and it is transferred to sludge drying bed via sludge regulating valve. The Sludge shall be demoisturized in sludge bed. The supernatant clarified water passed thru tube media & flows by gravity to Filter Feed tank and from this point it is pumped to pressure sand filter for the removal of suspended solids. Again it passes through activated carbon filter for the removal of remaining BOD. Now the treated water is available for any means of disposal.

The Filter Press (optional) further concentrates the sludge and converts it into sludge cakes. The sludge cakes are removed and are ideal for use in land filling material as well as manure. The filtrate water is transferred to collection cum equalization tank. Treated water can be used for horticulture application as well as toilet flushing. The sludge collected shall be used as manure for the plants.

### 4. SCHEME OF TREATMENT

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SCREEN CHAMBER &amp; GREASE TRAP UNIT.</td>
</tr>
<tr>
<td>2.</td>
<td>EQUALIZATION-TANK FOR EQUALIZING EFFlUENT WITH DIFFUSERS</td>
</tr>
<tr>
<td>3.</td>
<td>AERATION CHAMBER WITH DIFFUSERS &amp; BIO-PACK MEDIA</td>
</tr>
<tr>
<td>4.</td>
<td>SECONDARY CLARIFIER / TUBE SETTLER</td>
</tr>
<tr>
<td>5.</td>
<td>PRESSURE SAND FILTER</td>
</tr>
<tr>
<td>6.</td>
<td>ACTIVATED CARBON FILTER.</td>
</tr>
<tr>
<td>7.</td>
<td>SLUDGE DRYING BEDS / FILTER PRESS.</td>
</tr>
<tr>
<td>8.</td>
<td>TREATED WATER TANK</td>
</tr>
</tbody>
</table>

NOTE: The material like bio pack media, fill pack media, tube media, pipes and valves are always in excess quantity.
TECHNICAL SPECIFICATION FOR WATER TREATMENT PLANT (WTP)

SCOPE OF WORK
This specification covers the design, fabrication and installation of a combination reverse osmosis/electrode ionization system at ALIMCO KANPUR. Every effort will also be made to minimize waste and recover all wastes economically recoverable.

GENERAL REQUIREMENTS
The water treatment system shall be capable of treating station raw water to produce 86,400 gallons per day net output of demineralized water in accordance with the conditions of service, required performance, materials and construction stated in this specification.

The water treatment system shall consist of a pre-treatment section, reverse osmosis (RO) section and a post-treatment section. The pre-treatment section will condition the water before it goes into the RO section. The pre-treatment section shall include filtration and de-chlorination, softening and ultraviolet sterilization. Softening equipment shall include a saturation tank and regeneration facilities. Booster pumps in the pre-treatment section will supply the necessary pressure to drive water through the RO elements and the post-treatment equipment.

The RO section shall be divided into two 100% capacity trains. Each train shall have a minimum of two-stages in which Concentrate water from the first stage feeds the second stage.

The post-treatment system will remove the remaining dissolved solids. It will consist of one membrane based degasifies and two electrode mineralizers which will treat the water to boiler make-up water specifications.

WORK FURNISHED BY SUPPLIER
The major items of equipment furnished by the Supplier shall include, but not be limited to the following:

A. Two 100% activated carbon/multimedia filters (capable of flowing 100% when the second unit is in backwash), two 100% sodium cycle softeners, two 100% 5μ cartridge filters, one 100% ultraviolet sterilizer, two booster pumps, two 100% reverse osmosis trains, piping to and from one 100% membrane degasifies and to and from two 100% electrode mineralizers and along with connections and piping into demineralized water storage tanks (Condensate tanks).

Pumps for backwashing softeners and filters using Reclaim water tank shall also be provided.

B. Regeneration equipment for softeners.

C. Local and CRT based controls and instrumentation as required for the automatic and/or manual operation of the water treatment system in accordance of this specification.
Alimco Township Village Hora Bangar, Kanpur (UP)

D. Integral and interconnecting piping, valves and fittings within the limits as specified

E. Technical Services Representative, Construction Manager and Startup Engineer.

F. Labor for unloading, handing and erection of all apparatus at the job site.

G. Concrete foundations, trenches, sumps and anchor bolts as required.

H. Piping and controls to reclaim storage tank for water re-use.

I. Interface electrical wiring, conduit, grounding and connections between the skids and from skids to the control board.

J. Motor starters for all motors with local MCC for system isolation.

K. Piping, valves and fittings within Supplier’s terminal limits specified

L. All pneumatic lines with Supplier-furnished control panel.

M. A concrete building or buildings to house control panel, pretreatment and post-treatment equipment and suitable to withstand wind from typhoons.

N. 120 V AC single phases and 480 V AC three-phase power source for control and motors, respectively.

O. Brine saturator tank and brine pumps.

P. CS+FRP Lining Reclaim water tank for reclaiming RO reject and rinse water.

Q. The space for a small Chemical Lab. Inside building which as used to perform manual analysis for quality control.

CONDITIONS OF SERVICE – PROCESS DESIGN

Capacity

A. There are two trains reverse osmosis/EDI water treatment system, each Train shall have the capacity to deliver a net output per day, the two Trains Alternate operation of the water quality.

B. The net output of the water treatment system is defined as the amount of demineralized water actually available for make-up use and excludes water discharged to waste during the normal operation of equipment or used for backwashing filters or softeners.

C. Each softener bed shall have sufficient ion exchange material to operate at least for 24 hours continuously before requiring generation.
PRETREATMENT EFFLUENT REQUIREMENTS

D. The effluent from the pretreatment section of the water treatment system shall be designed to produce a silt density index (SDI) of 3 or less, using an elapsed time of 15 minutes.

E. The effluent from the pretreatment section of the Apparatus shall have the following properties.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cl₂</td>
<td>Less than 0.02 ppm</td>
</tr>
<tr>
<td>Total Hardness</td>
<td>Less than 0.5 ppm as CaCO₃</td>
</tr>
</tbody>
</table>

REVERSE OSMOSIS MODULES
The reverse osmosis system shall reduce the feed water conductivity by at least 98% and reduce the feed water silica by 99% operation.

MEMBRANE CLEANING AND CHEMICAL DOSING

F. Membrane Clean-In-Pace (CIP) system
Contractor shall provide an individual and removable Clean-In-Place (CIP skid for Reverse Osmosis membrane cleaning/disinfection purposes. Portable skid design shall consist of control/monitor panel (switches and indicating lamps for main power, motor starter and tank immersion heater etc. are panel mounted) with extension lead power supply cable, pre-piped and pre-wired free-standing and open-top 250 gallons FRP cleaning solution preparation/storage tank, 316 stainless steel single-stage centrifugal transfer pump, immersion heater, flow meter, pH meter, thermometer, CIP inlet/outlet quick connections, isolation valves, CIP outlet cartridge filter (25-micron), and provide quick connected transfer hoses for the system demands.

The RO machine shall be provided with equipped (pre-piped) to perform a periodic cleaning of the RO membrane elements in order to restore lost product flow and/or product quality. The cleaning process shall be performed manually with the membranes remaining in the housings and the RO machine shutdown. The cleaning solution shall be re-circulated through the RO membranes via CIP. And the RO machine shall be equipped with CIP inlet/outlet isolation valves and quick connect cleaning connections.

The EDI machine shall be equipped with CIP inlet/outlet isolation valves and quick connect cleaning connections, to perform cleaning in order to restore lost product flow and/or product quality.

G. CHEMICAL DOSING SYSTEMS
Contractor shall provide each RO train with two chemical injection systems, one for membrane fouling prevention and pH adjustment the other one for membrane scaling prevention.

For membrane fouling prevention and pH adjustment, injection of chemical liquid shall be provided. The injection system shall consist of an electronic
positive displacement metering pump with PVC wetted parts, 35-gallon polyethylene day solution tank, electric solution mixer, liquid level switch, and foot valve. The pump is to be field-wired to the RO control panel to prevent the dosage of chemical during a machine shutdown or placed in stand-by. A status alarm shall be added to the control system during low chemical tank level.

For membrane scaling prevention, injection of anti-sealant shall be provided. The injection system shall consist of an electronic positive displacement metering pump with PVC wetted parts, polyethylene day solution tank, electric solution mixer, liquid level switch, and foot valve. The pump is to be field-wired to the RO control panel to prevent the dosage of chemical during a machine shutdown or placed in stand-by. A status alarm shall be added to the control system during low chemical tank level.

**POST-TREATMENT**

H. The post-treatment section shall consist of membrane base degasifies for carbon dioxide removal and electrode ionization equipment's.

I. The outlet pressure after the electrode ionizers (EDI) shall be at least 60 psig.

J. The electrode mineralizers shall polish the water to the specifications. Electrode mineralizers shall be operated at over 90% recovery. Supplier shall provide sufficient controls to allow each EDI train to be operated over the flows specified with minimal operator adjustments.

**EFFLUENT QUALITY FROM ELECTRODE IONIZATION**

K. The Electro ionization Units, when operating at the warranted rates of flow, shall reduce constituents in the effluent to the following acceptable values:

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Acceptable Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductivity</td>
<td>0.08 μS/cm @ 25°C</td>
</tr>
<tr>
<td>Silica (as SiO2)</td>
<td>&lt;10 ppb</td>
</tr>
</tbody>
</table>

L. Test methods used to determine the performance of the unit shall be as follows:

<table>
<thead>
<tr>
<th>Test</th>
<th>ASTM Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica</td>
<td>D 859 Referee Method B</td>
</tr>
<tr>
<td>Conductivity</td>
<td>D 1125</td>
</tr>
</tbody>
</table>
OPERATING CONDITIONS
Apparatus shall be installed indoors in a supplier furnished building, except for the brine and reclaim systems.

Equipment installed outdoors may be exposed to rain, high winds (including typhoons), blowing sand, salt mist or spray and ambient temperatures of 50 to 105°F.

DESIGN AND FABRICATION

R. The Supplier shall provide detail design control wire diagram, Layout, flow diagram including specify manufacturing and Model of all instruments, controller, Pumps, RO section needs to show detail flow from one vessel to another vessel in each stage. Etc. for GPA/TEMES Review within two months from award of the contract.

S. The Supplier shall furnish the pretreatment equipment, reverse osmosis modules and pumps, and softener regenerate equipment assembled and mounted on skids for ease of installation.

T. The Supplier shall complete the electrical wiring on the skids and complete the necessary interconnections among the controls, instrumentation and to the terminal boxes. Instrument wiring shall no the run through conduit with power wiring. Terminal boxes and conduit shall be dust-tight, weather-tight, and corrosion resistant.

ACTIVATED CARBON/MULTIMEDIA FILTERS

A. The activated carbon/multimedia filters shall be designed for the dual function of chlorine removal and suspended solids reduction.

B. Each activated carbon/multimedia filter shall have sufficient freeboard height to permit bed expansion of 50 percent. Freeboard provided shall be based on total volume of media; activated carbon, quartz and garnet.

C. Each activated carbon/multimedia filter shall be provided with vent valuing at the highest point and a drain connection at the lowest point.

D. Each activated carbon/multimedia filter shall have a 3 inch by 12 inch observation window centered at the top of the settled media bed.

E. The internal systems and components for each tank shall be constructed of 316L stainless steel.

F. Each activated carbon/multimedia filter tank shall have a neoprene rubber lining throughout.

G. Two activated carbon/multimedia filters shall be provided. The filters shall have a minimum activated carbon bed depth of 3.0 feet. Support beds will have the following minimum bed depths:
   #20 Quartz - 9 inches
   30 by 40 Garnet - 5 inches
   #8 Garnet - 4 inches
Quartz sub fill as necessary for distribution of backwash water.
The maximum in-service 100% flow rate for each filter shall be below 10 gpm/ft$^2$. Each filter shall be designed to handle 100% of the normal feedwater flow and the complete flow when the other filter is in backwash.

H. All piping downstream of the multimedia filters shall be schedule 80 CPVC.

I. Vendor shall provide all media needed and shall be responsible for loading the media.

J. Activated Carbon supplied shall be the following criteria:
   Carbon shall be hydrochloric acid-washed Calgon F200 12 X 40 Bituminous Grade Virgin (not reprocessed) carbon suitable for potable water use.

SODIUM CYCLESOFТЕNERS
K. Each softener shall have sufficient freeboard height to permit bed expansion of 50% percent without loss of resin unless using packed-bed technology.

L. Each softener shall be provided with vent valving at the highest point and a drain connection at the lowest point.

M. Each softener shall have an observation window centered at the top of the settle media bed and at the normal backwashing level (unless using packed-bed technology). The observation windows shall be vertical with minimum dimensions of 3 inches by 12inches.

N. The internal systems and components for each tank shall be constructed of 316L stainless steel. Laterals shall be screened with 50 mesh Wedge wire.

O. Each softener tank shall have 3/16-inch thick sheet Neoprene rubber lining throughout.

P. The softeners shall have a minimum bed depth of 3.0 feet. The maximum in-service 100% flow rate shall be 3gpm/ft$^3$.

Q. All piping downstream of the softeners shall be schedule 80 CPVC.

R. Softener shall be designed for down flow service and up flow regeneration (countercurrent regeneration).

ION EXCHANGE RESINS FOR SOFTENERS
Ion exchange materials for the softeners shall be provided consisting of properly graded and chemically stable uniform particle size bead strong-acid action resins. (the Resin is Amberlite or Dowex).

RESIN TRAPSTRAINER
A strainer shall be provided in the common effluent line of the sodium cycle softeners to prevent passage of resin. The strainer shall be designed to withstand the maximum system pressure. The strainer shall retain all particles larger than 50 mesh (U.S. Sieve Series) and shall utilize Johnson wedge wire.
BRINESYSTEM

S. Brine Pumps
1. Two Brine pumps shall be provided. One of the pumps shall be a spare.
2. Each pump shall be sized to deliver 150 percent of the maximum regenerate flow rate required.
3. Materials of construction for wetted parts in contact with the regenerate shall be Type 316 stainless steel for brine service.

T. Brine Mixing Tees
1. A brine mixing tee shall be provided for the regenerate system, capable of thoroughly mixing the incoming regenerate and dilution water to provide a continuous dilute solution of 10% w/w sodium chloride the dilution water come from Reclaim water Tank.
2. Materials of construction shall be 316L stainless steel for brine service. The end connections shall be flanged.

U. Salt Tank
1. A FRP brine saturator with a minimum capacity of 5 tons shall be provided along with lines and compartments to allow dry salt to be delivered and saturated salt solutions to be made up for regeneration the softeners. A manhole will be provided to minimize external contamination. Supplier will provide salt and fill up the tank for the initial operation of the system.
2. Filling of the brine saturation compartment shall be provided locally, Filtering of suspended material from the saturated brine shall be provided using sand or other suitable media drawing from a lateral system.
3. A ladder shall also be provided to allow access to the top of the saturator.
4. Level indication shall be provided for both dry salt and saturated liquid.
5. A drain line and flush connections shall also be provided for tank cleanout.

Cartridge Filters

V. Two 5μ cartridge filters shall be provided with each be sized for 100% flow.

W. Cartridge filters shall have the following features:
1. Filters shall be constructed in single 40 inch length, will be 2.5 inches in diameter and have a single open end with a Buna-N “o”-ring.
2. Filters shall be made entirely of poly propylene.
3. Cartridges shall have rating of 5 micron absolute.

X. Filter element change out shall be accomplished with no loose parts. No tie
rods shall be used to secure elements. Housing design shall allow filter change out in less than one hour. Cover shall be hinged and fastened with swing bolts. Tube sheet adapters shall be raised to prevent dirty fluid downstream during change out. Sufficient cartridges shall be provided to maintain a differential pressure of less than 4 paid across the housing at a flow rate of 95 gpm with new filters.

Y. Each cartridge filter housing shall be constructed of 316L stainless steel and shall have both a vent and drain valve.

Ultraviolet Sterilizer

Z. An ultraviolet sterilizer shall be provided to minimize bacteria in the feed to the RO system. Sterilizer shall allow easy change out of ultraviolet lamps.

AA. Sterilizer shall be constructed of stainless steel and designed for a flow rate of 95gpm.

Booster Pumps

A. Two booster pumps, complete with motor driver, coupling and baseplate, shall be provided. The pumps shall increase pressure to drive the water through the RO elements, the EDI, and to the top of the demineralized water storage tanks. Vents shall be provided on the discharge of the pumps.

B. The pumps shall be of the multistage centrifugal, each sized for 100% of the required system flow. Each pump shall be capable of delivering approximately 95 gpm at a discharge pressure from 150 to 300 psig. Pump and motor shall be encapsulated in a fiberglass pressure vessel for noise reduction. Pump shall be torpedo style pump from Pumps Unlimited.

C. Materials of construction for the wetted parts shall be 316 stainless steel.

RO Elements and Pressure Vessels

D. The reverse osmosis elements shall be 8” polyamide TFC membranes in a spiral wound configuration. Each of the two trains will have a minimum of 2 stages. The average flux for the RO membranes will not exceed 12 GFD. Supplier will provide computer projections for RO performance.

E. The pipe, valves and fittings (including tubing) used to interconnect the reverse osmosis permeate shall be 316L stainless steel Use of Victaulic couplings is permitted only for pipe J bends.

F. The reverse osmosis elements shall be arranged into 2 different trains on a common pressure rack.

G. RO flow will be maintained 67GPM per train will be controlled by the VFDs. RO reject shall be routed back to the Reclaim Tank for reuse using CPVC piping furnished by Supplier. Reject flow rate will be maintained at a constant flow rate independently of the permeate flow. The timer and level switch in RO water tank shall be control the duty and stand by for each RO Unit and can change it with PLC.
RO Flushing
Flushing of RO modules shall occur automatically upon shutdown or placed in stand-by and will be done using softened water from the pre-treatment system. An automatic dump valve shall be provided to protect the RO membranes upon shutdown or placed in stand-by as a means of reduces membrane scaling and fouling.

Degasified system

H. Permeate from the one RO trains shall be routed to three 6-inch Celgard membrane contactors to reduce carbon dioxide prior to the electrode mineralizers.

I. Membrane contactors shall include a blower and vacuum pump for carbon dioxide removal. Air removal equipment shall produce sufficient flow to reduce the carbon dioxide level below 4 ppm under all flow conditions. Blower shall produce oil-free air and will include a filter to meet the membrane manufacturer’s warrantee.

Electro-Demineralizers

J. An electrode ionizer system consisting of two 67 gpm trains shall be provided. Each will operate at over 90% recovery. Electrode ionizers shall be selected from one of the following EDI models: E-Cell MK-3 or CDI-LX. These are the only acceptable electrode ionizers.

K. Waste streams from the electrode mineralizers shall be routed back to GPA’s Raw Water Tank or Recycle for reprocessing using CPVC piping furnished by Supplier.

L. Each electrode mineralizer train shall be capable of meeting the limits defined in section 5.8 over a flow 60gpm.

M. Flow rate through the EDI units will be controlled by varying the RO flow rate using the VFDs. Any adjustments on the concentrate flow or pressure will take place automatically.

N. EDI voltage and or amperage can be done manually by the system operator.

Building and Construction

O. All equipment with the exception of the service water pumps, backwash pumps, the Reclalm water tank and the brine tank shall be enclosed within a concrete building supplied by the supplier. Building(s) shall include all necessary lighting to furnish lighting to 80 foot candles. Floor drains shall also be provided under the RO and EDI trains, each filter and softener.

Contractor is responsible for demolition and removal or relocated of old equipment, as well as installation of new equipment.

P. A CS+FRP Lining Reclalm tank shall be supplied to recover RO rinse and reject water. Tank shall be 20 feet in diameter with a height of 15 feet. Tank shall be used as a Reclalm water source for all softener Regenerate operations and for activated carbon/multimedia filter backwashes. In addition, the controls shall
allow the water to also be used for other purposes within the power plant as long as there is sufficient volume remaining to perform complete softener regeneration. Reclaim tank overflow line will terminate two inches above supplier-furnished funnel which will be connected to supplier’s pipe which will empty in storm drain.

Q. Construction of the entire water treatment system shall be the responsibility of the supplier. Construction shall include but is not limited pouring to all concrete pads (including those for the recovery water and the brine tanks), erection of the building and placement of all equipment within the building. In addition, electrical wiring from GPA's electrical panel shall be included in the scope of the project. All electrical, controls and air connections will be the responsibility of supplier. Project is to “turn-key”. Wiring from EDI skid-mounted control panel and instruments to PLC is also Supplier’s responsibility.

R. Minimum Electrical Test requirements: Contractor “Turn Key “Project

1. GPA will provide a 480V AC feeder supply and assure the correct operation and settings of all feeder protection.

2. Contractor shall be responsible for “ringing out” all new wiring prior to the initial energization and for modifying the construction drawings to an “as built “condition.

3. Contractor shall mugger all new wiring prior to initial energization.

4. Contractor shall be responsible for dynamic testing (where possible) of all new circuit protection devices prior to initial energization.

S. Contractor supplier shall provide specifications for the equipment enclosure/building. It shall meet be designed to meet all Federal and Local Codes and Seismic Zone 4 criteria. The design and specifications shall be reviewed and certified (signed) by a Registered Professional Engineer licensed to Practice and do business in the Territory of Guam. Design shall include but not limited to providing calculations, specifications and drawings for construction.

62 Controls &Instrumentation

A. General

1. Instruments and controls shall be of the solid-state electronic type and shall be suitable for use with pneumatic operated valves and shall be protected from the environment.

2. The automatic control systems, using PLC control (two sets and could transfer Automatically while operating set failed) shall be capable of the following functions:

   a. Place the water treatment system in service or stand-by condition with on-line operator interfacing using CRT touch screen or on-line mouse.
b. Provide for a gradual start up when the water treatment system is placed in service. The filter effluent shall be directed to reclaim tank until proper turbidity and the removal of total chlorine has been confirmed. The softener effluent shall be directed to reclaim tank until hardness and conductivity are verified. The RO product stream shall be directed to reclaim tank until the proper conductivity is verified. The electro demineralizer product stream shall be directed to reclaim tank until the proper conductivity is verified.

c. Place each activated carbon/multimedia filter in backwash when initiated with on-line operator interfacing using PLC control. Following initiation, the backwash cycle shall be completely automatic. After backwash and rinse, the filter shall be held in stand-by condition until returned to service with on-line operator interfacing using computer control.

d. Alarm on high differential pressure to indicate when the activated carbon/multimedia filters require back washing.

e. Regenerate each softener when initiated with on-line operator interfacing using PLC control. Only one softener shall be regenerated at a time so that the operation of the water treatment system is not interrupted. Following initiation, regeneration shall be completely automatic. After regeneration, the softener shall be held in stand-by condition until returned to service with on-line operator interfacing using computer control when the other softener exhausts.

f. Alarm on high differential pressure to indicate when the cartridge filters require replacement.
g. Rinse the RO elements for a minimum of ten minutes when the water treatment system is continued operation. The booster pumps and raw water pumps will continue to operate. At the lower RO feed pressure and/or with the appropriate valve actuation, no product shall be produced. All of the RO feed shall exit through the second stage concentrate waterlines.

h. Control pressure of influent water to provide constant pressure conditions for maintaining constant flow rates during filter backwashes.

i. Accomplish other functions as required for the proper operation of the water treatment system. Failure of any automatic operation to reach completion within the predetermined time interval, based on the quality end point criteria, shall be annunciated. Any such failure shall stop progress for the automatic process until correct conditions have been established.

j. Filling of brine saturator salt tank shall be manually initiated and controlled by the operator. Automatic high level shut-off switches shall be supplied to prevent overfilling.

3. The Supplier shall provide the means for manually accomplishing every operation from the water treatment system control panel which is performed by the automatic control systems.

Instrumentation Requirements

4. The two activated carbon/multimedia filters shall be provided with a differential pressure indicator and a high differential pressure alarm. Each filter shall be provided with flow meter.

5. A turbidity analyzer shall be provided downstream of the activated carbon/multimedia filters. The turbidity analyzer shall be equipped with a high turbidity alarm and a high turbidity shut down which shall shut down the water treatment system without rinsing the RO elements.

6. Each of the softeners shall be provided with a flow indicating totalizer. One common total hardness analyzer shall be provided for monitoring the effluent of the softener in-service. After a preset gallon age limit has elapsed, an alarm will annunciate to notify the operator that one of the softeners requires regeneration and the “exhausted” softener will continue to operate. In the event of high total hardness, the operated RO train shall be shut down for rinsing the RO Elements.

7. The two 5μ filters shall be provided with a differential pressure indicator for the combination, a differential pressure transmitter, and high differential pressure alarm.

8. Each booster pump shall be provided with a low suction pressure shut down, a high discharge pressure shut down, suction and discharge pressure gauges and a pressure relief valve. In addition, a discharge pressure transmitter shall be
provided. The high and low pressure shut downs shall shut down the system.

9. The combined permeate from both RO trains shall be equipped with a conductivity indicator and a high conductivity alarm. High conductivity shall shut down the operated RO train and put another RO train in service automatically/or manually.

10. The effluent of each electrode mineralizer train shall have a conductivity monitor. An alarm shall annunciate in the event of high conductivity. Each train shall be provided with an inlet and outlet pressure indicators.

11. The softener resin trap shall be provided with a differential pressure indicator and a differential pressure alarm.

Specific Requirements

In addition to the items listed below, the equipment provided by Supplier shall have the following features.

12. The programmable controller shall control all functions associated with softener regeneration, filter backwashing, RO module rinsing and electrode demineralizer operation.

13. All indicators and transmitters shall read out in engineering units. All flow indicators and transmitters shall read out directly in gallons per minute (gpm). All pressure indicators and transmitters shall read out directly in pounds per square inch (psi). All transmitters shall have linear output.

14. Flow indicators, locally mounted, shall measure the water flow rate each of the activated carbon/multimedia filters, the RO feed water flow to each RO train, and concentrate water from each RO train.

15. A flow indicator, locally mounted, shall measure the flow of dilution water to the brine mixing tee. Also a brine concentration meter to measure the concentration of the diluted brine used to regenerate the softeners shall be provided. Meter can be local and shall read out in percent sodium chloride.

16. A flow indicating, locally mounted “in-line” type, shall measure the flow rate of saturated brine. This indicator shall be sized for at least 150 percent of the expected flow rate.

17. A flow indicating totalizer, locally mounted, shall measure the flow through each softener, from the RO permeate of each train and the demineralized water flow to the storage tank. They shall indicate flow rate and shall have contacts to actuate the “volume exhausted” alarm point for the softeners.

18. A turbidity analyzer shall be provided for monitoring the activated carbon/multimedia effluent. Turbidity analyzer shall be Hach Model 1720D or equivalent.

19. A hardness analyzer shall be provided to monitor the effluent of the in-service softener. Hardness analyzer shall be a Hach Model 510 or equivalent.
20. A silica and TOC analyzer shall be provided for the combined EDI effluent. Silica analyzer shall be Hach Series 5000 or equivalent.

21. One annunciator, board mounted, with separate buzzer, to contain points as required for monitoring operation. The annunciator shall have a relay contact to transmit any of the aforementioned alarm to a single alarm window in the main control room. Wiring from the annunciator to GPA’s main control room shall be provided and installed by Supplier. Wiring shall be terminated at a single point in a terminal box. A test switch shall be provided to test operation of the annunciator lamps.
TECHNICAL SPECIFICATION FOR LIFTS

These conditions and specifications are intended to cover the complete installation, testing & commissioning of elevators in accordance with building plans as per specifications and shall be read in conjunction with general conditions of contract.

CODES/REGULATIONS

The work shall be carried out in accordance with CPWD general specification for electrical work (Part-III Lifts & Elevators) as per relevant IS codes of practice with regulation of local codes/Bye-laws as per the direction of Engineer-in-charge. The following codes/specifications shall be generally adhered to:

a. IS 1860 : Codes of practices for installation operation and maintenance of electric passenger and goods lifts.

b. IS 3534 : Outline dimensions of electric lifts

c. IS 466 : Specification for electric passenger/good lifts

d. IS 4289 : Specification for lift cables

POWER CONSUMPTION

Tenderer must furnish the power consumption of lifts along with submission of their bid.

DRAWINGS

Tender drawings – The tender drawings enclosed with the tender is essentially diagrammatic and indicate the lift well arrangement and sectional view. This drawings is intended only as guide to the tenderer for offering his quotation.

WORKING DRAWING

The elevator contractor shall prepare detail general arrangement drawing of the elevator plant including detailed sectional views, machine room layout, foundation details, brackets etc. and submit the same to the Engineer-in-charge within 30 days after the award of the work. All the drawings shall be submitted quadruplicate.

The approval of elevator contractors drawing by the Engineer-in-charge shall not absolve the contractor from any of his obligations as per contract.

LICENSE/ PERMIT / INSPECTION

1.) It shall be the Contractor’s responsibility to arrange for inspection of elevators by the inspector or local authority. The owners/Employers will only facilitate writing the application for inspection. However, the actual deposited fees, if any for the inspection shall be borne by the contractor. The Contractor shall also be responsible for follow up action and obtain and deliver to the Owner/Employer the license/ permit required under the local/ provincial / national regulations/bye-laws free of cost. Nothing extra whatsoever on this account shall be paid to the contractor.

2.) The Contractor shall also carry out all tests/ operations as required by the inspector or local Authority to obtain the approval of elevator installation and operation of elevator plant and to submit the same to
the owner/employer. All such test, follow up action and liaison with inspector or local authority shall be deemed to be included in the prices quoted by the contractor and no extra payment on these account will be made to the Contractor. This liaison work shall be deemed to be the part of the contract.

POWER SUPPLY
The elevator shall be designed to operate at 415 Voltage, 3 phase, 4 wire 50 Hz. AC supply which shall be provided by the Owner/Employer in the lift machine room at the time of testing and commissioning of the elevators. However, the electric power for installation purpose shall be arranged by the Contractor at his own cost as detailed hereinafter. The equipment shall be able to function satisfactory under the following variation of power supply.

a. Voltage: ± 10%
b. Frequency: 3%
c. Combined voltage & frequency: 10%

LIFT WELL/MACHINE ROOM
1.) Lift/Elevator well ( shaft) and machine room will be provided at site. However, the Contractor shall check the correctness of the lift well ( shaft) and machine room and submit his inspection report to the Architect. Any corrective action required to the shaft, machine room shall be carried out by the Contractor, if required any, within their quoted rates.

2.) Any insert plates/ sleeves etc. required for installing the elevator shall be carefully carried out by the elevator Contractor and indicate the same in his detailed drawing and all such materials shall be procured by the Contractor within their quoted rates.

GUARANTEE

Performance Guarantee

a. The Contractor shall guarantee that all machine/ plants / installation covered under this contract will yield contract ratings and results and confirm to latest version of standards which are acceptable as good practices “and other accepted standards of relevant IS codes and NBC specifications.

b. The Contractor upon the completion of the work shall perform all the tests required to establish that the elevator plant is performing as per the contract rating, especially with regards to the load, speed systems, controls and accuracy.

c. If the performance tests do not yield the contract ratings, then the Contractor shall rectify/replace free of cost such equipment/ materials/plant and re-conduct the tests to demonstrate their correctness to the Engineer-in-charge and to submit all the test results carried out at site.

d. If the Contractor fails to carry out modifications required and establish the contract ratings of the plant the Owner/Employer shall impose a liquidated damage for not meeting the contract ratings.

e. The Contractor shall guarantee the entire lift installation as per specifications. All equipment shall be guaranteed for a period of one year from the date of acceptance against unsatisfactory performance or
breakdown due to defective design, manufacture and installation. The installation shall be covered by the condition that whole installation or any part thereof found defective within one year from the date of taking over shall be replaced or repaired by the contractor free of cost.

f. The guarantee shall cover the following:
   i) Quality, strength and performance of materials and equipment used.

   ii) Safe electrical and mechanical stresses on all arts of the equipment under all specified conditions of operations.

   iii) Satisfactory performance during guarantee period including free replacement to be done in accordance with maintenance instruction and schedules.

   iv) Performance figure and other values as specified in the schedule of guaranteed technical particulars.

   v) Prompt service during twelve (12) months free maintenance period for repairs and break downs. The tenderer shall five full particulars of local facilities available such as address, phone numbers, name of person available, stock of spares etc.

   vi) Attending to damages to consignment of lift items supplied and installed due to defective workmanship, materials, design etc, to any part from manufactures supply.

MAINTENANCE

After completion of the installation, testing and commissioning of the elevator plant by the Contractor, he shall provide, free of cost, maintenance service for a period of 12 months from the date of handing over of successful commissioning of the elevator to the owner. The maintenance service shall include regular examination of the plant by trained personnel, all necessary adjustments, greasing, oiling, cleaning, supplies of genuine standard parts of mechanical/ electrical component, inclusive of indication lamps to keep the equipment/ plant in proper operation. The maintenance service shall also be provided during contract period as and when required for smooth commissioning of lifts without any extra charges.

PAINTING

All exposed metal work furnished by Contractor under these specification shall properly be painted after installation.

Civil work if any to be done by Contractor at his own cost:
Contractor shall provide /carry out the following steel work at his own cost.

a. Necessary scaffolding in the hoist way required during the erection of the elevators which shall be provided by the contractor at his own cost. Scaffolding materials will remain Contractor’s property which they may take away the same after commissioning /handing over the lift to the owner/employer after their due permission.

b. All minor building work necessary for installation of equipment’s such as cutting holes in the walls/ floor for lift car, counter weight rail bracket, hall button and indicators including placing of steel in position making of opening in wall/floor either of RCC of brick masonry etc and restoring these to
original conditions and finish. The scope of minor building work include all grouting of foundation, concrete pads, inertia block etc to be formed or made as base for supporting RS joists, bolts, installation in position of RS Joists in machine room, lift well wherever necessary.

c. Supply of necessary RS joists of angle iron support brockets etc for installation of lifts in the machine room or other places as may be necessary including their installation in position.

d. All electrical work except bringing in main connection and earth connection to the machine room terminated on suitable switch fuse unit/ boards.

e. Any construction work/treatment required for preventing the water flow/seepage into the lift pit/well due to subsoil water, rain water to any other reason shall be carried out by the contractor at his own cost.

f. De-watering of all kinds in connection with the work to prevent water floor/seepage into lift pit/well due to subsoil water, rainwater or any other reason whatsoever shall be done by the contractor at his own cost till defects liability period of contract. Nothing extra whatsoever shall be paid to the contractor on this account.

g. Necessary covering of cutouts in the flooring in machine room to cover the open areas after installation of the machine.

h. Steel items such as machine bears for control panels, buffer support channels, ladder in pit. Stretches/ separator angle in lift wall etc.

i. Hoisting beam, foundation for control panels and equipment’s in the lift machine room.

j. Temporary barricades with caution boards at each landing to prevent accidents during execution of work.

k. Supply and installation of sheet fascia plates with necessary clamps, bolts, supports etc. as are necessary in connection with the installation of lifts.

l. Display of instruction on landing as per appendix ‘C’ of CPWD General Specifications (part-III) lifts 1981 as amended up to date.

After successful completion of work and handing over the elevators to the owner/ employer, the Contractor shall impart training to the staff designated by the owner/employer for the purpose for smooth operation of the elevators without any extra charges.

**ELECTRICITY AND WATER**

i) The Contractor shall arrange at his own cost the electric power required for carrying out the works including provision of operation and maintenance of generators of the required capacity to provide electricity for the above purpose at his own cost. The Contractor shall be primarily responsible for ensuring uninterrupted supply of electric power required for the use in the work throughout the erection and commissioning period.
ii) The contractor shall make his own arrangement with permission of local authority for providing treated water required in connection with the work and for labor/staff employed in the work including adequate storage facilities for water at his own cost.

The Contractor shall ensure uninterrupted supply of water for all above purposes and he shall be responsible to satisfy himself that the water arranged by him is fit for construction purpose and consumption by labor and shall adequately treat such water whenever it is not found suitable for such purpose. No ground water or water received form de-watering for any purpose whatsoever shall be drawn and used in the work or for labor.

iii) Watch and ward for electricity and water shall be made by the Contractor’s at his own cost for safe custody of materials.

PROVISIONS BY OWNER/EMPLOYER BY FREE OF COST.

a) Provision for three phase 4 wire 50 Hz. Power Supply terminated with suitable sized Triple Pole and Neutral switch fuse units with double earthing. The location of the Main Switches shall be on the walls near the entrance of the machine rooms.

b) Provision of single phase 50 Hz. AC power supply terminated with suitable sized single phase and neutral switch fuse unit for

   i) Lighting in machine room, lift wells, lift pits.
   ii) Lighting outlet points in the lift shaft

Notes: The lift supplier shall indicate the requirements and capacity of switches for above terms.

c) Properly ventilated machine room, lift shafts and water proofed lift pits. However, if due to any reason whatsoever any water proofing is required, the same is to be done by the contractor at his own cost and nothing extra shall be paid on this account.

d) Lockable accommodation (without any guard) for storage of equipment's.

e) Trap door in the machine rooms.

f) Necessary covering of cutouts in the flooring in machine room to cover the open areas after installation of the machine.

g) Architrave’s works at entrance to lifts.

Contractor’s liability for damage caused and imperfections notices within the maintenance period.

If the contractor or his service team shall break, deface, injure or destroy any part of the building in which they are working or if any damage shall happen to the work in the progress of work, from any cause whatsoever or if any defect appears in the work within 12 months after final certificate or otherwise of its completion shall have been given by the engineer-in-charge arising out of defective or improper materials or workmanship the contractor shall upon receipt of notice in writing on that behalf make the same good at his expense. In case of default on the part of contractor, the Engineer-in-charge may get the same done good at his risk and cost.
Care shall be taken by the contractor in handling/stacking of materials to avoid damage to the building. On completion of the lift installation contactor shall remove all debris and leave the machine room and other areas used by him a clean state.

**SPECIFICATION FOR THE WORK**

1.) The work shall be executed in strict conformity to CPWD General Specifications for Electrical works (Part-III Lift) 1981 (as amended up to date) and the modifications technical or otherwise as ordered by Engineer-in-charge.

2.) Inspection testing and commissioning.

Initial inspection by the NBCC at works of manufacturer NBCC shall inspect the stores at the works of manufacture on intimation by the contractor that the equipment is ready for inspection. The inspection materials duly stamped and insured shall be dispatched to the site by the contractor expeditiously.

Testing- The contractor shall perform testing as per CPWD General Specifications for Electrical work (part III Lift) 1981 and as amended up to date.

Inspection during installation and final inspection- The contractor shall arrange with the owner/employer for checking and testing the lift as per CPWD General Specification for Electrical works (part-III Lift)1981. The installation shall not be accepted until the NBCC is satisfied of its compliance with the requirements of the specifications in all respects. After satisfactory compliance as above, the final report duly signed by the contractor and countersigned by the Engineer-in-charge shall be prepared before issuance of completion certificate as given in CPWD General Specification for Electrical works (Part-III Lifts)1981.

All instruments and materials required for testing shall be responsibility of lift contractor.

Trial run period- After the satisfactory final inspection as stated, the contractor shall demonstrate the trouble free running of lift for a period of not less than 30 days before taking over by the owner/employer. During this period, the lifts may be kept either in automatic or manual mode by NBCC. After the installation has been run without any major break down during thirty days period, the lift installation shall be deemed to have run trouble free if the number of break down during this period is not more than four calls excluding false calls and leveling defects.

Date of acceptance- Date of taking over the installation shall be reckoned after thirty (30) days of trouble free operation of the equipment. Any undue wear and tear of components during the running period shall be made good by the contractor free of cost.

After sale service: The elevator contractor shall provide adequate and prompt after sale service in terms of maintenance personnel and spares as and when required.

Completion plans (As-Built Drawings): The contractor/manufacture shall submit completion drawings and controller system drawings along with completion certificate.

Fixtures to be provided in lift car: All lift care shall be provided with following fixtures in addition to those mentioned in technical specification for lift.
a) Stainless steel railing to be provided at suitable height to avoid damage to panels.
b) Drop ceiling with stainless steel louvers.
c) 2 Nos. 9W/11W CFL circular recess mounted in the drop ceiling.
d) Noiseless cabin fan suitably concealed behind false ceiling to throw air evenly.
### A. LIST OF APPROVED MAKES: CIVIL

<table>
<thead>
<tr>
<th></th>
<th>Material</th>
<th>Approved Makes</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Antitermite</td>
<td>Chlorpyriphos, Lindane emulsifiable concentrate of 20%, Permathrin, Cypermethrine, Fenvalerate.</td>
</tr>
<tr>
<td>2</td>
<td>Pre-Laminated Particle Board</td>
<td>Century, GreenPly, Marino, Durian</td>
</tr>
<tr>
<td>3</td>
<td>Pre-Laminated Ply Board</td>
<td>Century, GreenPly, Marino, Durian</td>
</tr>
<tr>
<td>4</td>
<td>Mineral Polymer Composite Jali</td>
<td>Ecoste, Alstone.</td>
</tr>
<tr>
<td>5</td>
<td>Toughened Glass &amp; Patch Fittings</td>
<td>Saint Gobain, Dorma, Geze, Ozone.</td>
</tr>
<tr>
<td>6</td>
<td>Cement</td>
<td>Ultratech, Birla, ACC, RAMCO, Ambuja, Shree, Devbhumi, Khyber, India Cements, Chetinad, Dalmia, Barak Valley, Cement Corporation of India Limited, Meghalya Cement Ltd, Grasim Cement Lafarge Cement, Century Cement, Cement Manufacturing Co. Ltd., Holcim(Bangladesh)</td>
</tr>
<tr>
<td>7</td>
<td>Structural Steel</td>
<td>TISCO, SAIL, VIZAG, Devbhumi, Kamdhenu, Kashmir Steel Rolling Mill, JISCO, IISCO, Jyoti, Amba</td>
</tr>
<tr>
<td>8</td>
<td>MS Tubular Sections</td>
<td>TISCO, SAIL, VIZAG, JINDAL, Rathi, Prakash, Ravindra</td>
</tr>
<tr>
<td>9</td>
<td>Reinforcement Steel</td>
<td>TATA, SAIL, VIZAG, Kamdhenu, Rathi, Jyoti, Devbhumi, Amba, Barnala, Kashmir Steel Rolling Mill, Jindal or equivalent</td>
</tr>
<tr>
<td>10</td>
<td>Glazed tiles</td>
<td>H &amp; R Johnson, Kajaria, Somany, Naveen, Bell, Asian</td>
</tr>
<tr>
<td>11</td>
<td>Ceramic tiles floor finish for Building</td>
<td>Kajaria, Nitco, Regency, Somany, Naveen, Bell, Asian, Rak</td>
</tr>
<tr>
<td>12</td>
<td>Ceramic tiles for toilet flooring</td>
<td>Kajaria, Nitco, Regency, Somany, Naveen, Bell, Asian, Rak</td>
</tr>
<tr>
<td>13</td>
<td>Vitrified Tiles</td>
<td>H &amp; R Johnson, Kajaria, Somany, Naveen, Bell, Nitco, Asian, Rak</td>
</tr>
<tr>
<td>14</td>
<td>Flush doors</td>
<td>India Plywood Mfg. Co., Kutty flush doors, Diamond, Lakshmi. (Exterior grade only), Syntex, Kit Ply, Alpro Panel</td>
</tr>
<tr>
<td>No.</td>
<td>Item Description</td>
<td>Brands/Manufacturers</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>15</td>
<td>Plywood</td>
<td>National, Kitply, Greenply, Anchor, Sitaboard, India Plywood Mfg. Co.</td>
</tr>
<tr>
<td>16</td>
<td>Water proofing compounds</td>
<td>Fosroc, Multi Plas, Cico, Impermo, Acco – Proof</td>
</tr>
<tr>
<td>18</td>
<td>Water proof cement paints</td>
<td>Snowcem plus, Surfacement, Nitcocem, Nitcole, Birla Plus, Cico Cem</td>
</tr>
<tr>
<td>19</td>
<td>Glazing, Glass</td>
<td>Indo-Asahi, Modi Float, Saint Gobain</td>
</tr>
<tr>
<td>20</td>
<td>Aluminium doors, windows, partition etc</td>
<td>INDALCO, ZINDAL, Ajit India, Alumilite, Nalco, Hindalco</td>
</tr>
<tr>
<td>21</td>
<td>Hardware</td>
<td>Shalimar, Garnish, Navbharat, Vision, Amarbhoy, Dossaji, EBCO, HETTICH, HAFFELE</td>
</tr>
<tr>
<td>22</td>
<td>Stainless Steel Railing</td>
<td>Dorma, Kitch, Jinadal Arch, Ozone.</td>
</tr>
<tr>
<td>23</td>
<td>Textured Paint</td>
<td>Spectrum, Coral</td>
</tr>
<tr>
<td>24</td>
<td>Wooden Flooring</td>
<td>Power Floor, Kronotek, Span, Floor Master, Pergo</td>
</tr>
<tr>
<td>25</td>
<td>Plaster of Paris</td>
<td>Shriram, JK, Aerostone</td>
</tr>
<tr>
<td>26</td>
<td>Cement White</td>
<td>Birla White, JK White</td>
</tr>
<tr>
<td>27</td>
<td>Hardware</td>
<td>EBCO, HETTICH, HAFFELE</td>
</tr>
<tr>
<td>28</td>
<td>Locks</td>
<td>Dorset with separate keyhole ring, Golden, Kitch</td>
</tr>
</tbody>
</table>
## B. LIST OF APPROVED MAKES: ELECTRICAL

<table>
<thead>
<tr>
<th></th>
<th>Product Description</th>
<th>Approved Makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>ACB with short ckt, over load, Earth fault with time lag facility</td>
<td>L&amp;T (U-Power), MG (Masterpact), Siemens (3WL), ABB (E-MAX)</td>
</tr>
<tr>
<td>30</td>
<td>ACB with short ckt, over load, Earth fault with time lag facility</td>
<td>L&amp;T (C Power), Merlin Gerin (Enerpact), ABB (E MAX with PR III), Siemens (3-WL)</td>
</tr>
<tr>
<td>31</td>
<td>MCCB with short ckt, over load, Earth fault with time lag facility</td>
<td>L&amp;T (DSine), MG (compact), Siemens (Sentron-3VL), ABB (ISO MAX, TMAX)</td>
</tr>
<tr>
<td>32</td>
<td>MCB</td>
<td>Legrand, Hagger, MG, ABB</td>
</tr>
<tr>
<td>33</td>
<td>ELCB</td>
<td>Legrand, Hagger, MG, ABB</td>
</tr>
<tr>
<td>34</td>
<td>LT Cables</td>
<td>Skytone, Havells, Proflex</td>
</tr>
<tr>
<td>35</td>
<td>LT Cable (Control)</td>
<td>Skytone, Havells, Proflex</td>
</tr>
<tr>
<td>36</td>
<td>PVC Insulated Cu wires (FRLS)</td>
<td>Skytone, Havells, Proflex</td>
</tr>
<tr>
<td>37</td>
<td>Cable Gland Double Compression</td>
<td>Stripwel, Comet, Baliga</td>
</tr>
<tr>
<td>38</td>
<td>PVC Rigid Conduits</td>
<td>AKG, BEC, Polypack, SG</td>
</tr>
<tr>
<td>39</td>
<td>MS Conduits</td>
<td>AKG, BEC, NIC</td>
</tr>
<tr>
<td>40</td>
<td>Switches, Sockets, Plugs etc.</td>
<td>Crabtree, Clipsal Oval, Legrand Mosaic, SG Controls, Philcon</td>
</tr>
<tr>
<td>41</td>
<td>Industrial Socket in Steel Enclosure</td>
<td>Clipsal, MDS, SG Controls</td>
</tr>
<tr>
<td>42</td>
<td>Ceiling Rose</td>
<td>Anchor, Lisa</td>
</tr>
<tr>
<td>43</td>
<td>Telephone Cable, Telephone Outlets</td>
<td>Skytone, Gloster, Finolex</td>
</tr>
<tr>
<td>44</td>
<td>Tagblock with boxes</td>
<td>Krone Type or as approved</td>
</tr>
<tr>
<td>45</td>
<td>Luminaires</td>
<td>Philips, Syska (SSK), Osram, Bajaj</td>
</tr>
<tr>
<td>46</td>
<td>HT Cables</td>
<td>Gloster, Skytone, Havell’s</td>
</tr>
<tr>
<td>47</td>
<td>HT Termination kit</td>
<td>Raychem, M-Seal, Birla3M, Denson</td>
</tr>
<tr>
<td>48</td>
<td>Cable Tray, Wire ways</td>
<td>Needo, Ricco, Pilco</td>
</tr>
<tr>
<td>49</td>
<td>Instrument Cable</td>
<td>Lapp Kabel, Nicco, Skytone</td>
</tr>
<tr>
<td>50</td>
<td>Lugs</td>
<td>Dowell’s, HAX</td>
</tr>
<tr>
<td>51</td>
<td>Termination Control Cable</td>
<td>Elemex, Wega, Phonex, Belden, Reliance, Nicco, Paramount, Cords Cable, Pirelli or equivalent approved by OTPC</td>
</tr>
<tr>
<td>52</td>
<td>DB’s</td>
<td>Legrand, Hager, MG, ABB</td>
</tr>
<tr>
<td>53</td>
<td>Rubber Mats</td>
<td>Jyoti</td>
</tr>
<tr>
<td>54</td>
<td>Lightning Arrestor</td>
<td>Indlec, Unex, Jaipuria, Jaishree</td>
</tr>
<tr>
<td>55</td>
<td>Digital Meter</td>
<td>Enercon, Ducati, Secure</td>
</tr>
<tr>
<td>56</td>
<td>Bus Bar Aluminium</td>
<td>Jindal, Indalco, Century</td>
</tr>
<tr>
<td>57</td>
<td>Bus Bar Copper</td>
<td>Sterlite</td>
</tr>
<tr>
<td>58</td>
<td>Bus Duct (Air Insulated type)</td>
<td>System &amp; Power Control, Jackson, Havell’s</td>
</tr>
<tr>
<td>60</td>
<td>Elevators</td>
<td>Kone, Otis, Thysenkrupp, Schlinder, Johnson Lifts, ECE</td>
</tr>
</tbody>
</table>
### C. LIST OF APPROVED MAKES: PLUMBING & FIRE FIGHTING

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Approved Makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>Wash Basin</td>
<td>Hindware, Neycer Sheraton, Oval, Parry Noble, Cera, Kohler</td>
</tr>
<tr>
<td>62</td>
<td>Wash Basin Fixture</td>
<td>Hindware, Neycer Sheraton, Oval, Parry Noble, Cera, Kohler</td>
</tr>
<tr>
<td>63</td>
<td>Three Hole Basin Mixer With Pop-Up</td>
<td>Jaquar Continental Range, Gem</td>
</tr>
<tr>
<td>64</td>
<td>Bottle Trap</td>
<td>Jaquar Continental Range, Gem</td>
</tr>
<tr>
<td>65</td>
<td>Waste Coupling</td>
<td>Jaquar Continental Range, Gem</td>
</tr>
<tr>
<td>66</td>
<td>Angle Valve With Wall Flange</td>
<td>Jaquar Continental Range, Gem, Arco</td>
</tr>
<tr>
<td>67</td>
<td>Water Closet</td>
<td>Hindware, Neycer Futura With Cistern, Cera With Cistern</td>
</tr>
<tr>
<td>68</td>
<td>Head Shower With Arm</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>69</td>
<td>Soap Dish</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>70</td>
<td>Robe Hook</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>71</td>
<td>Towel Rack</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>72</td>
<td>Kitchen Sink Mixture</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>73</td>
<td>C.P. Braass Bib Tap</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>74</td>
<td>Towel Rail</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>75</td>
<td>Towel Ring</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>76</td>
<td>Curtain Rod</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>77</td>
<td>Bottle Opener</td>
<td>Jaquar, Gem</td>
</tr>
<tr>
<td>78</td>
<td>Pressure Type Liquid Soap Container</td>
<td>Bobrick</td>
</tr>
<tr>
<td>79</td>
<td>No Touch Hand Drier</td>
<td>Kopal, Euronics, Gem, Toshi</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Brand(s)</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>80</td>
<td>C.P. Flate Nut Connector With</td>
<td>Gem</td>
</tr>
<tr>
<td>81</td>
<td>C.P. Pipes 375 Mm Long</td>
<td>Gem</td>
</tr>
<tr>
<td>82</td>
<td>Flush Valve For Urinal</td>
<td>Robo Flush, Jaquar, Euronics</td>
</tr>
<tr>
<td>83</td>
<td>Kitchen Sink</td>
<td>Star Flow, Jayana</td>
</tr>
<tr>
<td>84</td>
<td>Mirror</td>
<td>Modi Float Glass</td>
</tr>
<tr>
<td>85</td>
<td>CPVC Pipes</td>
<td>Ajay Flowguard, Arestel</td>
</tr>
<tr>
<td>86</td>
<td>CPVC Fittings</td>
<td>Ajay Flowguard, Arestel</td>
</tr>
<tr>
<td>87</td>
<td>Ball Valves</td>
<td>Zoloto, C&amp;R, Fouress, KBL, R&amp;D multiples, BDK, L&amp;T, Akay industries, Crescent Valves Mfg., AV Valves, KSB, Leader valves, Fischer Sanmar Ltd., Valtech</td>
</tr>
<tr>
<td>88</td>
<td>Butterfly Valves</td>
<td>Zoloto, KSB, C&amp;R, Fouress, KBL, R&amp;D multiples, BDK, L&amp;T, Advance valves, Tyco, Fluidline Valves</td>
</tr>
<tr>
<td>90</td>
<td>Water Flow Meters</td>
<td>Copstion, Kranti</td>
</tr>
<tr>
<td>100</td>
<td>Globe Valves</td>
<td>Zoloto, Leader, Fouress, KBL, R&amp;D multiples, BDK, L&amp;T, Valtech, A.V. Valves, Weir, Babcock Borsig, Crescent Valves, Federal Hardware, Fluidline, Steelstrong, Petrol Valves, KSB, Audco</td>
</tr>
<tr>
<td>101</td>
<td>Sanitaryware</td>
<td>Hindustan, Parryware</td>
</tr>
<tr>
<td>102</td>
<td>Seat Cover</td>
<td>Commander (Heavy Duty)</td>
</tr>
<tr>
<td>103</td>
<td>C.P. Fittings</td>
<td>Gem</td>
</tr>
<tr>
<td>104</td>
<td>Plastic Water Tanks</td>
<td>Sintex, Polycon, Renu</td>
</tr>
<tr>
<td>105</td>
<td>Stainless Steel Sink</td>
<td>Neelkanth, Amc</td>
</tr>
<tr>
<td>106</td>
<td>CI Pipes, Fittings &amp; Manhole</td>
<td>Nicco</td>
</tr>
<tr>
<td>107</td>
<td>CI Pipes</td>
<td>Nicco</td>
</tr>
<tr>
<td>108</td>
<td>RCC Pipes</td>
<td>Anand, Local ISI Marked</td>
</tr>
<tr>
<td>109</td>
<td>Stoneware Pipes, Traps</td>
<td>Perfect, Burn, Local ISI Marked</td>
</tr>
<tr>
<td>110</td>
<td>PVC Pipes, Fittings</td>
<td>Supreme, Finolex</td>
</tr>
<tr>
<td>111</td>
<td>Pump</td>
<td>Grundfos, KSB, Flowmore, WPIIL, Mather &amp; Platt, Sulzer, KBL, Jyoti Ltd., Weir, Flowserve, Beacon Weir, Su Motors</td>
</tr>
<tr>
<td>112</td>
<td>Pipes</td>
<td>TATA, SAIL, Jindal or equivalent</td>
</tr>
<tr>
<td>113</td>
<td>Motor</td>
<td>Bharat Bijlee, ABB, CGL, Siemens, Alstom, Kirlosker Electricor equivalent</td>
</tr>
<tr>
<td>114</td>
<td>STP</td>
<td>Thermax, Indian Ion Exchange &amp; Chem Ltd or equivalent</td>
</tr>
<tr>
<td>FLOOR</td>
<td>TYPE-I (QTY.)</td>
<td>TYPE-I AREA (SQ. MT.)</td>
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<tr>
<td>------------</td>
<td>---------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>FIRST</td>
<td>0</td>
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</tr>
<tr>
<td>SECOND</td>
<td>4</td>
<td>58.24 x 4 = 232.96</td>
</tr>
<tr>
<td>THIRD</td>
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<td>58.24 x 4 = 232.96</td>
</tr>
<tr>
<td>FOURTH</td>
<td>4</td>
<td>58.24 x 4 = 232.96</td>
</tr>
<tr>
<td>TOTAL</td>
<td>12</td>
<td>698.88</td>
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