AN ISO 9001 & 14001 COMPANY

TENDER DOCUMENT

TENDER No: DLI/CON/728/505

FOR

Construction of Hostel Building HOD, Bachelor Quarters, Workshop, External Electrification, Internal Road, Boundary wall etc., including Civil, PHE and Electrical work for New Polytechnic Institute at Sahebganj, Jharkhand

VOLUME - II

Additional Conditions of Contract, Technical Specifications & Drawings
CONSTRUCTION OF NEW POLYTECHNIC INSTITUTE AT SAHEBGANJ, JHARKHAND
DEPTT. OF HIGHER & TECHNICAL EDUCATION, GOVT. OF JHARKHAND

ADDITIONAL CONDITIONS OF CONTRACT

1. Intent:

These additional conditions of contract (ACC) shall be read in conjunction with the Instructions to the Tenderers & General Conditions of Contract for the work of Construction of New Polytechnic Institute at Sahebganj, Jharkhand. These Additional Conditions of Contract shall supercede the instructions to the Tenderers & General Conditions of Contract (G.C.C.) wherever they are at variance.

2. Site:

The site is about 455 km by Road and 471 km by Rails from Ranchi, measuring 11.48 Acres.

3. Scope of work:

The contractor shall be responsible for supply, construction, supervision and commissioning of Hostel Building HOD Quarters, Bachelor Quarters, Work Shop, Boundary wall, Internal Road, Drainage System, External Electrification, Water Supply system including water tank, other campus development work for the proposed New Polytechnic Institute at Sahebganj, Jharkhand as per the technical specifications, designs, drawings, instruction and terms and conditions given in the tender documents.

4. Tender Documents:

4.1 Following documents shall form the complete set of Tender Documents for this contract.

4.1.1 Instructions to the Tenderers & General Conditions of Contract – 128 Pages

4.1.2 Notice Inviting Tender.

4.1.3 Additional Conditions of Contract

4.1.4 Technical Specification and Tender Drawings

4.1.5 Form of Price Bid

4.1.6 Bill of Quantities

4.2 Notwithstanding sub-division of the documents into separate sections, every part shall be deemed to be supplementary of every other part and shall be read with and into the contract.
5. Tender Price & Amount:

5.1 The tenderer shall fill up the prescribed format of Price Bid (enclosed) forming part of tender documents, with his rates at percentage below, above or par (both in figures and words) the estimated cost for each head separately in summary cost he will be willing to execute the work. The tenderer shall take due notice of other requirements of clause 4 of Instructions of Tenderers.

5.2 Comparative estimate after tendering has to be approved by Deptt. of Higher & Technical Education (Client).

5.3 All other terms and conditions will be as per G.C.C. and Instruction to the Tenderer.

6. Secured Advance:

Secured advance shall be admissible to the contractors under the guidelines of G.C.C. (Cl. No. 35.0) if the owner agrees to pay such advance.

7. Payment:

In addition to Cl. No. 37 of General Conditions of Contract, the following shall also govern the terms of payment:

7.1 Payment will be made based on measurements entered in Measurement Book (MB) & certification of the same by Engineer – in-charge. The owner (Deptt. of Higher & Technical Education) may arrange for checking the MB by Civil Engineers of Govt. Engineering College/Polytechnic or equivalent organization. The contractor shall remain bound to render all assistance to the Engineer – in-charge or his authorized representative during such checking of the measurements.

8. Compensation for Delay and Remedies:

The rates of agreed Compensation stipulated at Clause 72.1 of G.C.C. shall be read amended as under:

8.1 In case completion of the project is delayed due to reasons attributable to the contractors/agencies/suppliers engaged for the project by the PMC, PMC shall impose liquidated damages @ 0.5% (zero point five percent) on awarded contract value for each week of delay subject to a maximum of 10% (Ten percent) of the awarded contract value which shall be credited to the Department.

9. Challan & Royalty etc.

Contractor at time of submission of each bill shall produce royalty clearance certificate/challan against payment of royalty of materials used for the work. In case he fails to submit such certificate/challans along with the bill, the royalty for materials will be deducted from each RA Bill against work done as per the prevailing directives of the State Mining Department.
10. Progress Monitoring, Quantity & Quality Check:

Time schedule and progress monitoring shall be guided by C. No. 43 of G.C.C. However the owner reserves his right to monitor the progress including all technical requirements of work in association with the representatives of EPI or themselves. The owner also reserves the right to get the quantity & quality of work tested by another Government agency or Private body. The Contractor shall have no objection to such monitoring and testing and shall be deemed to have include the expenses to be incurred on such accounts in the rates as agreed in the Contract.

11. Carriage of materials:

Carriage of materials will be paid for the items quoted based on Jharkhand Schedule of Rates (JSR) 2011 only as mentioned in the tender. If the lead is found less than provided in the tender payment will be made as per actual lead. No payment towards extra carriage over provision made in the tender will be admissible under any circumstances.

No payment for carriage of materials for the items quoted based on CPWD Schedule and Non-schedule items will be paid under any circumstances.

12. Accuracy of Works:

The various works to be done true to line, level and grade. The periodical checking by the supervising engineer shall not absolve the contractor of his responsibility regarding accuracy. In case any deviations or discrepancy in the line, level or grade the contractor shall make good discrepancy at his own cost and without any compensation for the additional work involved.

13. Mobilization Advance:

Mobilization advance of 12% of the total individual project value at the annual interest of 12% and as mentioned in memorandum of the tender document will be released as under:

13.1 50% of Mobilization advance after fulfillment of conditions in Cl. 8.1 (i) of G.C.C.

13.2 Balance 25% of Mobilization advance after fulfillment of conditions in Cl. 8.1 (ii) & 8.1 (iii) of G.C.C.

Other provisions of Cl. 8.0 of GCC shall remain unaltered.

14. Escalation Clause:

The escalation will be paid if approved and paid by Department of Higher & Technical Education, Government of Jharkhand (The client), as per clause 47 of standard bidding document applicable in Jharkhand government department as given below.
Contract Price shall be adjusted for increase or decrease in rates and price of materials in accordance with the following principles and procedures and as per formula given below in the contract data. **This will be paid to the contractor only when the client, Department of Higher & Technical Education will release the payment/fund against this clause.**

The price adjustment shall apply for the work done from the start date given in the contract data up to end of the initial intended completion date or extensions granted by the Engineer and shall not apply to the work carried out beyond the stipulated time for reasons attributable to the contractor.

The price adjustment shall be determined during each month from the formula given in the contract data.

Following expressions and meanings are assigned to the work done during each month:

\[ R = \text{Total value of work done during the month. It will exclude value for works executed under variations (Extra Items) for which price adjustment will be worked separately based on the terms mutually agreed and approved by Department of Science and technology (The Client).} \]

To the extent that full compensation for any rise or fall in costs to the contractor is not covered by the provisions of this or other clauses in the contract, the unit rates and prices included in the contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs.

The formula (e) for adjustment of prices is:

\[ R = \text{Value of work as defined above.} \]

**Adjustment for labour component**

(i) Price adjustment for increase or decrease in the cost of labour shall be paid in accordance with the following formula.

\[ VL = 0.85 \times PL/100 \times R \times (L1 - L0)/L0 \]

\[ VL = \text{Increase or decrease in the cost of work during the month under consideration due to change in the rates of labour.} \]

\[ L0 = \text{The consumer price index for industrial workers for the state on 28 days preceding the date of opening of Bids as published by Labour Bureau, Ministry of Labour, Government of India.} \]

\[ L1 = \text{The consumer price index for industrial workers for the state for the month under consideration as published by Labour Bureau, Ministry of Labour, Government of India.} \]

\[ PL = \text{Percentage of Labour Component of the work.} \]

**Adjustment for cement component**

(ii) Price adjustment for increase or decrease in the cost of cement procured by the contractor shall be paid in accordance with the following formula:

\[ Vc = 0.85xPc/100xRxCi-C0)/C0 \]
Vc = increase or decrease in the cost of work during the month under consideration due to changes in rates for cement.

Co = The all India wholesale price index for cement on 28 days preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi.

Ci = The all India average wholesale price index for cement for the month under consideration as published by Ministry of Industrial Development, Government of India, New Delhi.

Pc = Percentage of cement component of the work

**Adjustment for steel component**

(iii) Price adjustment for increase or decrease in the cost of steel procured by the Contractor shall be paid in accordance with the following formula:

\[ V_s = 0.85 \times P_s/100 \times R \times (S_i - S_0)/S_0 \]

Vs = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for steel

So = The all India wholesale price index for steel (Bars and Rods) on 28 days preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi.

Si = The all India average wholesale price index for steel (Bars and Rods) for the month under consideration as published by Ministry of Industrial Development, New Delhi.

PS = Percentage of steel component of the work

Note: For the application of this clause index of bars and rods has been chosen to represent steel group.

**Adjustment of POL (Fuel and lubricant) component:**

(iv) Price adjustment for increase or decrease in the cost of POL (fuel and lubricant) shall be paid in accordance with the following formula:

\[ V_f = 0.85 \times P_f/100 \times R \times (F_1 - F_0)/F_0 \]

Vf = Increase or decrease in the cost of work during the month under consideration due to changes in rates for fuel and lubricant.

F0 = The official retail price of High Speed Diesel (HSD) at the existing consumer pumps of IOC at nearest center on the day 28 day prior to the date of opening of Bids.

F1 = The official retail price of HSD at the existing consumer pumps of IOC at Nearest center for the 15th day of month of the under consideration.

Pf = Percentage of fuel and lubricant component of the work.

Note: For the application of this clause, the price of High Speed Diesel oil has been chosen to represent fuel and lubricants group.
Adjustment of other materials component:

(v) Price adjustment for increase or decrease in cost of local materials other than cement, steel, bitumen and POL procured by the contractor shall be paid in accordance with the following formula:

\[ V_m = \frac{0.85 \times P_m}{100 \times R_x(M_i - M_o) / M_o} \]

\( V_m \) = Increase or decrease in the cost of work during the month under consideration due to changes in rates for local Materials other than cement, steel, bitumen and POL.

\( M_o \) = The all India wholesale price index (all commodities) on 28 days preceding the date of opening of Bids, as published by the Ministry of Industrial Development, Government of India, New Delhi.

\( M_i \) = The all India wholesale price index (all commodities) for the month under consideration as published by Ministry of Industrial Development, Government of India, New Delhi.

\( P_m \) = Percentage of local material component (other than cement, Steel, bitumen and POL) of the work.

The following percentages will govern the price adjustment for the entire contract:

1. Labour – P1 35%
2. Cement – Pc 5%
3. Steel – Ps 5%
4. POL – Pf 5%
5. Other Materials – 50%
Total – 100%

15.0 Specified material as per Technical Specifications 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.

16.0 ARBITRATION : Modification of arbitration’s clause no 76.0 of GCC

16.1 Clause no. 76.1 along with note of GCC

**Deleted** - There shall be no Arbitration Clause for this Contract except between Central Public Sector Undertakings inter se / Government of India Departments / Ministries as mentioned in the Clause No. 76.2 below:-
ARBITRATION BETWEEN CENTRAL PUBLIC SECTOR ENTERPRISES INTER SE / GOVERNMENT OF INDIA DEPARTMENTS / MINISTRIES

i) In the event of any dispute or difference relating to the interpretation and application of the provisions of the contracts, such dispute or difference shall be referred by either party for arbitration to the sole arbitrator in the Department of Public Enterprises. The Arbitration and Conciliation Act, 1996 shall not be applicable to arbitration under this clause. The award of the Arbitrator shall be binding upon the parties to the dispute, provided, however, any party aggrieved by such award may take a further reference for setting aside of the award to the Law Secretary, Department of Legal Affairs, Ministry of Law & Justice, Government of India. Upon such reference the dispute shall be decided by the Law Secretary or the Special Secretary/ Additional Secretary, when so authorized by the Law Secretary, whose decision shall bind the Parties finally and conclusively. The parties to the dispute will share equally the cost of arbitration as intimated by the Arbitrator.

ii) Subject to any amendment that may be carried out by the Government of India from time to time, the procedure to be followed in the arbitration shall be as is contained in O.M. No. 4(1)/2011-DPE (PMA) GL dated 12.06.2013. Of Department of Public Enterprises, Ministry of Heavy Industries and Public Enterprises, Govt. of India or any modification issued in this regard.

17.0 Deployment of Technical Staff for the work

<table>
<thead>
<tr>
<th>Requirement of Technical Staff</th>
<th>Minimum experience (Years)</th>
<th>Rate of recovery (₹/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualification</td>
<td>Number</td>
<td></td>
</tr>
<tr>
<td>i) Project Manager with degree</td>
<td>1</td>
<td>₹ 60,000/- p.m</td>
</tr>
<tr>
<td>ii) Planning /Quality Control Engineer Degree</td>
<td>1</td>
<td>₹ 50,000/- p.m</td>
</tr>
<tr>
<td>iii) Junior Engineer Diploma (Civil)</td>
<td>1</td>
<td>₹ 25,000/- p.m</td>
</tr>
<tr>
<td>iv) Safety Officer</td>
<td>1</td>
<td>₹ 20,000/- p.m</td>
</tr>
<tr>
<td>v) Supervisors (Diploma Engineering in Electrical/ Mechanical/Civil or ITI)</td>
<td>2</td>
<td>₹ 30,000/- p.m</td>
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<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Rate of recovery in case of non-compliance of above will be stipulated as above.
TECHNICAL SPECIFICATIONS
FOR
CIVIL WORK
TECHNICAL CONDITIONS AND IMPORTANT SPECIFICATION

(CIVIL WORKS)

1 Principles of design of concrete mix.
   i) The design of concrete mix shall be based on latest CPWD specifications.
   ii) The concrete mix shall be designed for the specified target mean compressive
       strength in order to ensure that the work-tests results do not fall below the
       acceptance criteria specified for the concrete mix.
   iii) Grades of concrete mix stipulated design criteria.
   iv) The reinforced cement concrete work shall be executed using concrete mix of grade
       as specified in the nomenclature of the item of work. The various grades of
       concrete shall be designed for the strength criteria and other parameters.
   v) In the designation of a grade of concrete mix, the letter ‘M’ stands for mix and the
       number represents the characteristic compressive strength (fck) of 15 centimeter
       cube at 28 days expressed in Newton per square millimeter, i.e., N/mm2.
   vi) A grade of concrete mix shall be designed and tested for a specified target mean
       compressive strength.
   vii) The contractor shall exercise very good quality control over site conditions
       for production of controlled concrete by employing automatic weigh batching of all
       materials grading of aggregate, determination of moisture contents and control of
       water-cement ratio frequent supervision and regular workability, strength tests and
       maintaining adequate field laboratory facilities to maintain the specified quality of
       concrete consistently.

2 Materials

   Cement aggregate and water shall in general conform to provision of PWD
   specifications 1990 read with up to date correction slips

3 Design of concrete mix
   i) The contractor shall engage one of the following approved laboratories/test houses
      for designing the concrete mix in accordance with relevant is codes and to conduct
      laboratory tests to ensure the target strength and workability criteria for a given
      grade of concrete

      (a) I.I.T., Delhi.
      (b) National Council for Cement and Building Materials, Ballabhgarh.
(c) CRRI, Delhi

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

ii) 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.

iii) Any change in source or characteristics 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.

iv) All cost and charges of designing the concrete mix and its testing by approved laboratories 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.

4 Production of controlled concrete

Mixing of Concrete

i) Automatic batching plant conforming to relevant IS code and of required capacity shall be used for production of controlled concrete.

ii) Automatic batcher shall be charged by devices which, when activated 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.

iii) 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.

iv) The mixers shall be free fall tilting type conforming to latest IS code.

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

vi) 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.

vii) The aggregate of different sizes shall be stockpiled separately preferably a day before use.
viii) 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.

ix) It is important to maintain the water cement ratio constant at its specified or approved value.

x) All other operations involved in concrete work like laying, placing, compaction and curing etc. shall be done as per PWD specifications 1990 with up to date correction slips.

5 Sampling and strength of work test of concrete

Sampling

i) Samples from fresh concrete shall be taken and the test cubes shall be made cured and tested in accordance with relevant IS code.

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

iii) 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.

iv) At least one test sample shall be taken on the day of completing.

v) Each grade of concrete shall require different testing.

Test strength of a sample

vi) 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.

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

viii) 50% of the total tests shall be done at the field laboratory established at the site of work and the remaining 50% of total test shall be got done from the laboratory as approved by Engineer-in-charge.

6 Standard of acceptance of concrete work

i) Out of the six specimen cubes of a test sample three cubes shall be tested at 7 days and the remaining three cubes at 28 days.
ii) The test results at 7 days are only intended to indicate the likely strength at 28 days and to decide the continuation of further concrete work.

In case, the 7 days test results do not satisfy the specified strength criteria, all further work structurally inter linked with the concrete work represented by the sample, shall be stopped and the test results of the remaining three cubes at 28 days shall be awaited before proceeding further with the work or the work shall be carried out as per the written directions of the Engineer-in-Charge.

The contractor shall have to setup a fully equipped field laboratory to conduct field tests for conducting tests in addition to the tests which shall be conducted from outside laboratory; for which nothing extra shall be payable.

**Test results at 28 days**

iii) The average compressive strength of the sample at 28 days shall alone form the basis of acceptance of concrete work and the payment under the contract subject to the specified criteria for acceptance.

iv) The concrete work of each grade and a lot shall be assessed separately.

v) The concrete shall be assessed daily for strict compliance of the specified acceptance criteria.

vi) The concrete shall be deemed to comply with the strength requirements.

vii) The concrete work shall liable to be rejected if it is porous or honey combed; its planning has been interrupted without providing a proper construction joint, the reinforcements have been displaced or it does not satisfy the specified dimensional tolerance as per relevant IS code.

7 **Measurements**

i) The measurements of work and the allowable tolerances shall be governed by provisions of PWD specifications 1990 read with up to date correction slips.

ii) The theoretical consumption of cement in design mix concrete shall be worked out on the basis of proportions approved.

8 **Rate**

i) The rate shall include cost of all materials used and labor involved in all operations described above including the cost of designing and testing of concrete mix in the approved laboratory but excluding the cost of centering and shuttering and reinforcement.

ii) The average compressive strength of each test sample shall govern the rate payable.
for the concrete represented by the sample.

iii)  The concrete which does not meet the strength requirement as specified but has strength greater than that specified nothing extra shall be paid for that.

iv)  The payment for different grades of concrete shall be made strictly as indicated in the structural drawings for the work. No extra payment for richer mix projecting into any other member during concreting of junctions of columns beams and slabs etc. shall be made except otherwise admissible as per structural drawings.

**LIST OF APPROVED MAKE**

<table>
<thead>
<tr>
<th>S.No</th>
<th>ITEMS</th>
<th>MAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ISI marked PVC Pipe for Rain Water</td>
<td>Diplast, Prince, Supreme, Atul</td>
</tr>
<tr>
<td>2.</td>
<td>ISI marked UPVC Sanitary Pipe (SWR)</td>
<td>Diplast, Prince, Supreme, Atul</td>
</tr>
<tr>
<td>3.</td>
<td>G.I. Pipe</td>
<td>Tata, Jindal (Hisar)</td>
</tr>
<tr>
<td>4.</td>
<td>CP Fittings</td>
<td>ISENBERG, BOLAN ISI marked, JAQUAR</td>
</tr>
<tr>
<td>5.</td>
<td>ISI marked China Wares Wash Basin &amp; WC</td>
<td>Parry ware, Hind Ware, BOALN, ROCA</td>
</tr>
<tr>
<td>6.</td>
<td>Seat Cover ISI Mrked</td>
<td>Comander, Duralite, Perryware, Hindware, Cera</td>
</tr>
<tr>
<td>7.</td>
<td>PVC Cistern 7.5 liter Capacity</td>
<td>Perry ware; HindWare; Cera</td>
</tr>
<tr>
<td>8.</td>
<td>ISI marked Stainless steel sink</td>
<td>Jayana, Diamond, Nilkanth, Nirali, Kingston</td>
</tr>
<tr>
<td></td>
<td>With CP waste</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>ISI marked Aluminum Door/ Window Fittings (Anodized)</td>
<td>Hindalco, Domal, Shuko, WICONA</td>
</tr>
<tr>
<td>10.</td>
<td>Paint 1&lt;sup&gt;st&lt;/sup&gt; Quality</td>
<td>Nerolac, Berger, ICI, Asian, Dulux</td>
</tr>
<tr>
<td>11.</td>
<td>Exterior cement based decorative Paint</td>
<td>Killick Nixon, Asian, Berger</td>
</tr>
<tr>
<td>12.</td>
<td>Washable Distemper 1&lt;sup&gt;st&lt;/sup&gt; quality</td>
<td>Berger Paint; Asian Paint; ICI</td>
</tr>
<tr>
<td>13.</td>
<td>Pressed Steel Chowkat</td>
<td>All BIS approved manufacturer or any other firm approved by the Chief Engineer</td>
</tr>
<tr>
<td>14.</td>
<td>ISI marked Flush door shutters</td>
<td>Kingcobra, Green, Duro, Century</td>
</tr>
<tr>
<td>15.</td>
<td>LLDPE Storage tank ISI marked</td>
<td>Sintex, Diplast, Atul, Aqua Plus, Amitex, Unitex</td>
</tr>
</tbody>
</table>

ENARCH CONSULTANTS Pvt. Ltd.
### COMBINED TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>Item</th>
<th>Brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.</td>
<td>Ceramics glazed floor &amp; wall tiles</td>
<td>Kajaria, Somany, Nitco, Varmora</td>
</tr>
<tr>
<td>17.</td>
<td>Glass</td>
<td>AIS (ASAI GLASS), SAINT GOBAIN, PILKINGTON</td>
</tr>
<tr>
<td>18.</td>
<td>Cement</td>
<td>Birla, Binani, Ultratech</td>
</tr>
<tr>
<td>19.</td>
<td>Reinforcement steel</td>
<td>SAIL, RINC, TATA</td>
</tr>
<tr>
<td>20.</td>
<td>Lifts and elevators</td>
<td>Johnson, Schindler, OTIS, KONE</td>
</tr>
<tr>
<td>21.</td>
<td>S.S. Railings</td>
<td>KONCEPT, DELINE, DELINK, OZONE</td>
</tr>
<tr>
<td>22.</td>
<td>Texture wall finish</td>
<td>Spectrum, Ultratech, Dulux</td>
</tr>
<tr>
<td>23.</td>
<td>ISI marked PVC door shutters</td>
<td>Duroplast, Orchid, Sintex</td>
</tr>
</tbody>
</table>

### ELECTRICAL ITEMS

<table>
<thead>
<tr>
<th></th>
<th>Item</th>
<th>Brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ISI marked rigid PVC pipe (Medium quality)</td>
<td>Diplast, Precision, Polycab, Atul</td>
</tr>
<tr>
<td>2.</td>
<td>ISI marked MS conduit pipe (Medium quality)</td>
<td>AKG, BEC, NIC, ATUL</td>
</tr>
<tr>
<td>3.</td>
<td>ISI marked wire and Cable with copper conductor with fire retarded insulation</td>
<td>Finolex, Polycab, ASPL, Havells.</td>
</tr>
<tr>
<td>4.</td>
<td>ISI marked Piano Type Switches &amp; ISI marked Modular Switch and sockets</td>
<td>Anchor, Precision, SSK, Adhunik, legrand</td>
</tr>
<tr>
<td>5.</td>
<td>ISI marked Button holder; Ceiling Rose; Bell</td>
<td>Anchor, SSK, Precision, Vinay.</td>
</tr>
<tr>
<td>6.</td>
<td>ISI marked MCBs &amp; MCBs enclosures &amp; ELCBs</td>
<td>Siemens, schneider, Adhunik</td>
</tr>
<tr>
<td>7.</td>
<td>PVC Junction Box</td>
<td>Any ISI marked</td>
</tr>
<tr>
<td>8.</td>
<td>Bakelite Sheets</td>
<td>Formica, Starlam, Hylam, Super Hylem</td>
</tr>
<tr>
<td>9.</td>
<td>LT Panel, Air insulated busduct, Rising Mains</td>
<td>Conquerent, Adlec, Tricolite</td>
</tr>
<tr>
<td>11.</td>
<td>HT panels</td>
<td>Areva, Adhunik, Siemens</td>
</tr>
</tbody>
</table>

**Note**

1. In respect of materials for which approved makes are not specified above, the same shall be decided by the GM, NBCC or his representative and shall be as per sample got approved from GM, NBCC and consulting Architect before procurement. The Contractor shall submit samples of all such materials 3 months before the date of start of such work for approval from the GM, NBCC or his appointed representative through consulting Architect.
2. The Contractor shall produce samples before procurement of the material for approval for all materials required for works. Samples can be submitted from any of the above makes and they shall confirm to specifications. Samples as approved by the GM, NBCC shall only be used on the works and the decision of the GM, NBCC or his appointed representative regarding make of material shall be final. Only ISI marked will be allowed to use on works.

3. In case material bearing BIS/ ISI certification mark are not available, the quality of material shall be judged by standard laid down in the relevant BIS/ ISI specification for which make / brand shall be got approved from GM, NBCC or his appointed representative.

TECHNICAL SPECIFICATIONS
FOR
(PLUMBING AND SANITARY WORKS)
SPECIAL CONDITION OF CONTRACTS
(PLUMBING AND SANITARY WORKS)

1. SCOPE OF WORK
a) Supply & Installation of sanitary ware, CP fittings, Toilet paper holders etc. complete as required starting from suction line from underground tank. The distribution Ring Main, butterfly Valves, N.R.V, Elect-Panel level indicators with Panel for starting the bore well pump for replenishment of water in OH tank sump, painting of all pipes & installation as directed.
b) Supports for vertical risers/ vertical pipes. Painting etc. as required.
c) Rain water harvesting system.
d) Irrigation System.
e) Maintaining the installation minimum for a period of 1 year from the date of commissioning/ virtual completion, whichever is later.
f) Earth pits & earth strip for earthing the body of the motors is being provided by the Electrical Contractor.

2. SCHEME:
As per drawings.

3. INSTALLATION SCHEMATIC
The installation shall confirm to the schematic line diagram attached in the shape of drawings for pump house.

4. SPECIFICATIONS
4.1 Work under Plumbing installation shall be carried out strictly in accordance with specifications attached with the tender.
4.2 Items not covered under these specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per specifications or the latest CPWD specifications as applicable in the work.

4.3 Works not covered under para 4.1 and 4.2 shall be carried out as per relevant Indian Standards and in case or its absence as per British Standard code of practice.

5. EXECUTION OF WORK

Since the work is to be executed in existing building, the Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads/building and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.

The work shall be carried out in conformity with the plumbing drawings and within the requirements of Architectural, HVAC, Electrical, and Structural and other specialized services drawings.

The Contractor shall cooperate with all trades and agencies working on the site. He shall not disturb the ongoing work in existing building. He shall make provision for hanger, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.

On award of the work, Contractor shall submit a schedule of construction in the form of a PERT chart or BAR chart for approval of the Project Manager/ Architect/ Consultant. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

6. Drawings

6.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

6.2 Architectural drawings shall take precedence over Fire drawing or other services drawings as to all dimensions.

6.3 Contractor shall verify all dimensions at site and bring to the notice of the Project Manager all discrepancies or deviations noticed. Decision of the Project Manager shall be final.

6.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small-scale drawings.

6.5 Any drawings issued by the Architects/ Consultant for the work are the property of the Architects/ Consultant and shall not be lent, reproduced or used on any works other intended without the written permission of the Architects/ Consultant.
7. **Inspection and testing of materials**

7.1 Contractor shall be required to produce original manufacturers test certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards. **NO PAYMENT SHALL BE MADE WITHOUT TEST CERTIFICATE OF THE ITEM.**

7.2 For examination and testing of materials and works at the site Contractor shall provide all testing and gauging equipment necessary but not limited to the following:

a) Theodolite.
b) Dumpy level.
c) Steel tapes.
d) Weighing machine.
e) Plumb bobs, Spirit levels, Hammers.
f) Micrometers, Tachometers.
g) Thermometers, Stoves.
h) Hydraulic test machine.
i) Smoke test machine.

7.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the Project Manager.

7.4 **All testing equipment shall be preferably located in special room meant for the purpose.**

8. **Metric conversion**

8.1 All dimensions and sizes of materials and equipment giver in the tender document are commercial metric sizes.

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

9. **Reference drawing**

9.1 Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All-important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.

9.2 All corrections, deviations and change made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialled by the Project Manager or Architects.

10. **Shop drawings**

Shop drawings shall be submitted under following conditions:

a) Showing any changes in layout in the Plumbing drawings.
b) Equipment layout, piping and wiring diagram.
c) Manufacturer or Contractor’s fabrication drawings for any materials or equipment supplied by him.

11. Completion drawings

11.1 On completion of work, contractor shall submit one complete set of original tracings and two prints of “as built” drawings to the Project Manager. These drawings shall have the following information.

a) Run of all piping, diameters on all floors, vertical stacks and location of external services.

b) Run of all fire lines with diameters, locations of control valves, access panels.

c) Locations of all mechanical equipment with layout and piping connections.

The certificate of virtual completion shall not be issued unless the above drawings are submitted.

11.2 Contractor shall provide five sets of catalogues, service manuals manufacturer’s drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

11.3 All “warranty cards” given by the manufacturers shall be handed over to the Project Manager/Consultants.

12. Contractor’s rates

12.1 Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

12.2 Rates quoted are for all heights and depths and in all positions, leads & lifts etc. as may be required for this work.

12.3 All rates quoted are inclusive or cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/ water proofing of appropriate mix and strength as directed by Project Manager. Contractor shall provide holes, sleeves, recesses in the concrete and masonry work as the work proceeds. Only Core cutting method is used for cutting structural member.

12.4 The Contractor shall furnish the Architects with vouchers & test certificates to prove that the materials are as specified and to indicate that the rates at which the materials are purchased in order to workout the rate analysis of non tendered items which he may be called upon to carryout.

13. Testing

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

13.2 Tests shall be performed in presence of the Project Manager/Consultant.

13.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.
13.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet municipal or other bye-laws in force.

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

14. Site clearance and cleanup

14.1 The contractor shall, from time to time, clear away all debris and excess materials accumulated at the site.

14.2 After the fixtures, equipment and appliances have been installed and commissioned, contractor shall clean-up the same and remove all plaster, paints, stains, stickers and other foreign matter or discoloration leaving the same in a ready to use condition.

14.3 On completion of all works, contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractor’s risk and cost.

15. Recovery of cost for materials issued to Contractors free of cost

15.1 If any materials issued free of cost to the Contractor, are damaged or pilfered, the cost of the same shall be recovered from the contractor on the basis or actual cost to owner which shall include all freight and transportation, excise duty, sales tax, Octroi, import duty etc, plus 50% on the total. The decision on the actual cost given by the Employer shall be final and binding on the Contractor.

16. Cutting of water proofing membrane

No walls terraces shall be cut for making and opening after waterproofing has been done without written approval of Project Manager/ Architects. Cutting of water proofing membrane shall be done very carefully so as other portion of water proofing is not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully waterproof as per specifications and details of waterproofing approved by Architects.

17. Cutting of structural members

No structural member shall be chased or cut without the written permission of the Project Manager.

18. Materials supplied by employer

The Contractor shall verify that all materials supplied by the Employer conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Project Manager.

19. Materials

Unless otherwise specified and expressly approved in writing by the Project Manager, only materials of makes and specification as mentioned in the list of approved makes attached herewith, shall be used.
TECHNICAL SPECIFICATIONS
(PLUMBING AND SANITARY WORKS)

1. SANITARY FIXTURES & CP FITTINGS

1.1 Sanitary fixtures shall be of the best quality approved by the Architect/Consultant. Wherever particular makes are mentioned, the choice of selection shall remain with the Architect.

1.2 All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the schedule of quantities, specifications, drawings, accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connection pieces.

1.3 Fixing screws shall be half round head chromium plated brass screws with C.P. washers where necessary.

1.4 Porcelain sanitaryware shall be glazed vitreous china of first quality free from warps, cracks and glazing defect. All wares shall be white unless otherwise given in the Schedule of Quantities. The Architect shall select colour of sanitaryware, when specified. Fixtures shall conform to IS 2566.

1.5 Sinks for kitchen shall be of stainless steel or as specified in the schedule of quantities.

1.6 Chromium plated fittings shall be cast brass chromium plated of the best quality approved by the Architects/Consultant.

1.7 All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturers recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faculty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.

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

2. SOIL, WASTE, VENT AND RAIN WATRE SYSTEM

2.1 CAST IRON PIPES AND FITTINGS:

2.1.1 PIPES:

a) All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. Pipes shall be sand cast iron soil pipes conforming to I.S. 1729.

b) TOLERANCE:

Acceptable tolerance for pipes to I.S. 3989 and I.S. 1729 shall be as follows:

- Wall thickness: -15%
- Length: +20 mm
- Weight: -10%
2.1.2 FITTINGS:

a) Fittings shall conform to the same Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specifications.

b) Fittings shall be of the required degree of curvature with or without access door.

c) Access door shall be made up with 3 mm thick insertion rubber washer and white lead. The bolts shall be fabricated with grease or white lead for easy removal later. The fixing shall be air and water tight.

2.1.3 FIXING:

2.1.3.1 All vertical pipes shall be fixed by M.S. (galvanised) clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

2.1.3.2 Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

2.1.3.3 Contractor shall provide all sleeves, openings, hangers, and inserts during the construction. All damages shall be made good to restore the surfaces.

2.1.4 Pipe Support

2.1.4.1 All Support shall be factory galvanised before used at site. All support shall be as per standard drawing issued with tender.

2.1.4.2 Where holder bat clamps are to be fixed in RCC column or slotted angels, walls or beam they shall be fixed with 40x3 mm flat iron “U” type clamps or as shown in drawing with anchor fasteners of approved design or 6 mm nuts and bolts.

2.1.4.3 Structural clamps shall be fabricated from M.S. structural members (galvanised) e.g. rods, angles, channels flats as per detailed drawing or as directed. Contractor shall provided all nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black enamel paint.

2.1.4.4 Slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in schedule or quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.

2.1.4.5 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 making good with cement concrete 1:2:4 mix (1 cement 2 coarse sand: 4 mm stone aggregate 20 mm nominal size) as directed by the Project Manager.

2.1.5 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 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centring floor the blocks. Size of the block shall be 30x30 cms of the required depth.

2.1.6 **FLOOR TRAP INLET**

Bathroom traps and connections shall ensure free and silent flow of discharging water. Where Contractor specified shall provide a special type GI inlet hopper without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and hopper inlet socket shall be threaded joint. Hopper shall be connected to a C.I. P or S trap with atleast 50 mm seal. Floor trap inlet hoppers and the traps shall be set in cement concrete blocks as specified in para above without extra charge.

2.1.7 **S.S.GRATING**

Floor traps shall be provided with 100-150 mm square or round C.P./Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4 mm or as specified in the Schedule of Quantities.

2.1.8 **JOINTING:**

Soil, waste vent and antisyphonage pipes shall be jointed with drip seal joint, jute rope shall be caulked to leave a minimum space for the dripseal to be poured in. After the pouring the lead shall be caulked into the joint with caulking tool and hammer, all surplus seal shall be cut and joint left flush with the rim of the socket neatly.

2.1.9 **CLEANOUT PLUGS:**

Contractor shall provide cast brass cleanout plugs as required. Cleanout plugs shall be threaded and provided with keyholes for opening. Cleanout plugs shall be fixed to the pipe a G.I. socket and dripseal joints.

2.1.10 **WASTE PIPE FROM APPLIANCES**

2.1.10.1 Waste pipe from appliances e.g. wash basins and sinks shall be of GI. All pipes shall be fixed in gradient towards the outfalls. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings.

2.1.10.2 **GI PIPES:**

Pipes shall be GI conforming to I.S. 1239 and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. tees, couplings, bends, elbows, unions, reducers, nipples, plugs. All GI waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

2.3 **TESTING:**

2.3.1 Before use at site all CI (soil, waste and vent pipes), shall be tested by filling up with water for at least 10 minutes. 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. Pipes with minor sweating may be accepted at the discretion of the Project Manager.
2.3.2 Pipes shall be tested after installation, by filling up the stack with water. All opening and connections shall be suitably plugged. The total head in the stack shall be however not exceed 3 m.

2.3.4 Alternatively, contractor may test all soil and waste stacks by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlets and connections. The top end shall, however, be left open. The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by the Project Manager.

2.3.5 A test register shall be maintained and all entries shall be signed and dated by Contractor and Project Manager.

2.4 uPVC pipes & fittings
   a) uPVC pipes for rain water system shall be unplasticized (rigid) PVC pipes conforming to I.S. : 4985 or IS 13592 of appropriate class as specified in schedule of quantities.
   b) Fittings for the pipes shall be injection moulded with approved type of sockets.
   c) Jointing shall be done as per the manufacturer’s recommendation. The pipes and fittings must have matching dimensions for a perfect joint. Loose for excessively tight joints in the system shall not be accepted. Fittings must have sufficient gap (approx. 10 mm) for permissible thermal expansion of pipes.
   d) Use proper uPVC pipe tailpieces adaptors for connections between cast iron pipes and uPVC pipes.

2.5 Cast iron pipes for drainage
   a) Cast iron pipes shall be centrifugally spun iron pipes conforming to I.S. 1536-1967. Quality certificates shall be furnished.

2.5.1 Fittings
   a) Fittings used for C.I pipe shall conform to I.S. 1538-1967.
   b) All fittings are ISI marked

2.5.2 Laying
   a) All cast iron pipes and fittings shall be jointed with best quality soft pig lead (conforming to I.S. 27-1977) which shall be free from impurities in wet trenches joints shall be made from lead wool. Nothing extra will be paid for lead wool joints. Depth of pig lead and weight for joints shall be as per I.S. code.
   b) The spigot of pipe or fittings shall be centered in the adjoining socket by caulking. Sufficient turns of tarred gasket will be given to leave unfilled the required depth of socket for depth of 45 mm when the gasket has been caulked tightly home. Joining ring shall be placed round the barrel and against the face of the socket. Molten pig lead shall then be poured to fill the remainder of the socket. This shall then be done in one pouring. The lead shall then be solidly caulked with suitable tools and hammers weighing not less than 2 kg.

2.6 Testing
a) Before use at site all CI/uPVC pipes shall be tested by filling up with water for at least 10 minutes. 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.

b) Pipes shall be tested after installation, by filling up the stack with water. All opening and connections shall be suitably plugged. The total pressure in the stack shall be however not exceed 6kg/sqcm.

c) A test register shall be maintained and all entries shall be signed and dated by Contractors and Engineer-in-Charge.

3. Water supply system

3.1 G.I. PIPES AND FITTINGS:

3.1.1 All pipes inside the buildings and where specified outside the building shall be galvanised steel tubes conforming to I.S. 1239 of class specified. When class is not specified they shall be heavy class.

3.1.2 Fittings shall be of malleable iron galvanised of approved make. Each fitting shall have manufacturer’s trademark stamped on it. Fittings for G.I. pipes shall include couplings, bends, tee, reducers, nipples, unions, and bushes etc. Fittings shall conform to I.S.1879.

3.1.3 Pipes and fittings shall be jointed with screwed joints using Teflon tape suitable for water pipes. Care shall be taken to remove burr from head of the pipe after cutting by a round file. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible.

3.1.4 CLAMPS

G.I. pipes in shafts and other locations shall be supported by M.S. (Galvanised) clamps of design approved by the Engineer-In-Charge. Pipes in wall chases shall be anchored by iron hooks. Pipes in shafts shall be supported on slotted angels/channels (Galvanised) as specified elsewhere.

3.1.5 UNIONS:

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

3.1.6 FLANGES:

Flanged connections shall be provided on pipes as required for maintenance/ease and dismantling or where shown on the drawings (on 25m straight run), all equipments connections as necessary and required or as directed by the Engineer-in-Charge. Connections shall be made with 3 mm thick insertion rubber washer by the correct number and size of the G.I. nuts/bolts as per relevant I.S.Standards and make. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Engineer-In-Charge. Bolt hole dia for flanges shall conform to the specification for C.I. sluice valve to I.S. 780. Gaskets shall conform to I.S. 11149.

4.0 PIPE PROTECTION
4.1 INSULATION
Hot Water pipes in chase shall be protected with 9mm thick closed cell expanded synthetic rubber pipe sleeve “VIDOFLEX” insulation.

4.2 TRENCHES:
All G.I. pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows except at places where welding/jointing etc. needs larger width of trench:

<table>
<thead>
<tr>
<th>DIA OF PIPE</th>
<th>TRENCH WIDTH</th>
<th>TRENCH DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 to 50 mm</td>
<td>30 cms</td>
<td>75 cms</td>
</tr>
<tr>
<td>65 mm to 100 mm</td>
<td>45 cms</td>
<td>100 cms</td>
</tr>
</tbody>
</table>

4.3 SAND FILLING:
G.I. pipes in trenches shall be protected with fine sand 15 cms around before filling in the trenches.

4.4 PAINTING:
All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code specified by Engineer-In-Charge.

4.5 PIPE PROTECTION
Where specified, pipes below floor or below ground shall be protected against corrosion by the application of PYPKOTE/MAKPOLYKOTE membrane 4mm thick. The application of membrane shall be as specified by the Manufactures.

5. GUNMETAL VALVES:
5.1 Valves 65 mm dia and below shall be heavy gunmetal ball valves or globe valves conforming to class I or I.S. 778. Valves shall be tested at manufacturer’s works and the same stamped on it.

5.2 All valves shall be approved by the Engineer-In-Charge before they are allowed to be used in the work.

6. TESTING:
6.1 All pipes, fittings and valves, after fixing at site shall be tested to a hydrostatic pressure of 1.5(not less than 10kg/sqcm) times the shut off head of the pump. Pressure shall be maintained for a period of at least thirty minutes without any drop.

6.2 A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and the Engineer-In-Charge.

7. External Sewerage and Drainage
7.1 Excavation
7.1.1 ALIGNMENT AND GRADE
The sewer/drain pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Project Manager/Project in-charge from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing to the Project Manager/Project in-charge.

7.1.2 EXCAVATION IN TUNNELS

The excavation for sewer/drain works shall be open cutting unless the permission of the Project Manager/Project in-charge for the ground to be tunnelled is obtained in writing. Where sewers/drain have to be constructed along narrow passages, the Project Manager/Project in-charge may order the excavation to be made partly in tunnel and in such cases the excavated soil shall be brought back later on for refilling the trenches or tunnel.

7.1.3 OPENING OUT TRENCHES

a) In excavating the trenches, etc. The solid road metalling, pavement, kerbing, etc. And turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully sifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Project Manager/Project in-charge and of the owners of the roads or other property traversed and the contractor shall not cut out or break down any live fence of trees in the line of the proposed works but shall order to the contrary.

b) The contractor shall grub up and clear the surface over the trenches and other excavation of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Project Manager/Project in-charge.

7.1.4 OBSTRUCTION OF ROADS

The contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The contractor shall obtain the consent of the Project Manager/Project in-charge in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

7.1.5 REMOVAL OF FILTH

The night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once to be provided by the contractor.

7.1.6 EXCAVATION TO BE TAKEN TO PROPER DEPTHS
The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating there to and so that the inverts may be at the levels given in the sections. In bad ground, the Project Manager/Project in-charge 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 sewers with concrete, broken stone, graven or other materials.

7.1.7 REFILLING

After the sewer/drain or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to sewer and other permanent work. The filling in the haunches and upto 75 cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15 cms layers with materials taken from the excavation, each layer being watered to assist in consolidation unless the Project Manager/Project in-charge shall otherwise direct.

7.1.8 CONTRACTOR TO RESTORE SETTLEMENT AND DAMAGES

The contractor shall, at his own costs and charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also, at his own expense and charges, repair and make good any damage done to buildings and other property. If in the opinion of the Project Manager/Project in-charge he fails to make good such works with all practicable despatch, the Project Manager/Project in-charge shall be at liberty to get the work paid by the contractor or deducted from any money that may be or become due to him or recovered from him in any other manner according to the law of the land.

7.1.9 DISPOSAL OF SURPLUS SOIL

The contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roads ways and sides left clear.

7.1.10 TIMBERING OF SEWER AND TRENCHES

a) The contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed, timbered in loose or sandy strata and below the surface of the sub soil water level.

b) The timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.
c) The contractor shall be held responsible and will be accountable for the sufficiency of all timbering, bracing, sheeting and pilling used as also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

7.1.11 SHORING OF BUILDINGS

The contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to person’s property resulting from any accident.

7.1.12 REMOVAL OF WATER FROM SEWER, TRENCH ETC.

a) The contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress not to the surface of any roads or streets, nor cause any interference with the use or the same by the public.

b) If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope, the full width of the trench shall be filled with concrete by the contractor at his own expenses and charges to the requirements of the Project Manager/Project in-charge.

7.1.13 WIDTH OF TRENCH

Recommended width of trenches at the bottom shall be as follows:-

- 100mm dia pipe 55cms
- 150mm dia pipe 55cms
- 225-250cms dia pipe 60cms
- 300mm dia pipe 75cms

Maximum width of the bed shall also be as above. No additional payment is admissible for widths greater than specified.

7.2 SALT GLAZED STONEWARE PIPES:

Stoneware pipes shall be new and of first class quality salt glazed and free from rough texture inside and outside and straight. All pipes shall have the manufactures name marked on it and shall comply with I.S. 651.

7.3 LAYING AND JOINTING OF STONEWARE SALT GLAZED PIPES:

a) Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before despatch each pipe shall be examined carefully on arrival at site. Each pipe shall be lightly struck with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes shall be segregated, marked in a conspicuous manner and their use in the works prevented by expeditiously removing them from the he work site.

b) The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep.
to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

c) Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete at the Contractor’s cost and charge.

8. REINFORCED CEMENT CONCRETE PIPES

8.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified as cast iron) shall be centrifugally spun S&S RCC pipes of specified class conforming to I.S. 458. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. The manufacturer shall test all pipes and the Contractor shall produce a certificate to that effect, from the manufactures.

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

8.3 JOINTING OF PIPES:

a) Tarred gasket shall first be wrapped round the spigot or each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly home so as to fill not more than one quarter of the total length of the socket.

b) The remainder of the socket shall be filed with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket if filled, a fitted shall be formed round the joint with trowel forming an angle of 45 degrees with the barrel of that pipe. The mortar shall be mixed as needed for immediate use and no mortar shall be beaten up and used after it has begun to set.

c) After the joint has been made any extraneous materials shall be removed from inside of the joint with suitable scraper of “badger”. The newly made joints shall be protected until set from the sun, drying winds, rain or dust, Sacking or other materials which can be kept damp shall be used. The joints shall be exposed and space left all round the pipes for inspection by the Engineer-In-Charge. The inside of the sewer must be left absolutely clean in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

9. MANHOLES AND CHAMBER:

9.1 All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:5 (1 cement: 5 coarse sand) or as specified in the Schedule of Quantities.

9.1 All manholes and chambers, etc. shall be supported on base of cement concrete of such thickness and mix as given in the schedule of quantities or shown on the drawing.
9.2 All manholes shall be provided with cement concrete benching in 1:2:4 nominal mix. (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size). The benching shall have a slope of 1:10 towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.

9.3 All manholes shall be plastered with 12/15 mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster.

9.4 All manholes with depth greater than 1m shall be provided with 20 mm square or 25 mm round PVC encapsulated foot rests set in cement concrete blocks 25x10x10 cms in 1:2:4 mix at 30 cms centre to centre vertically and staggered.

9.5 All manholes shall be provided with cast iron /SFRC covers and frames and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be as specified in the schedule of quantities.

10. **Water supply pumps**

Water supply pumps shall be of continuous operation type and suitable for fresh water. Pumps shall be single/multi stage; monobloc horizontal/vertical centrifugal pumps with SS/CI body and SS carbonate impeller, stainless steel shaft, carbon ceramics mechanical seal and coupled to a TEFC electric motor. Each pump should operate upto a curve-15m below specified head.

**Motor**

Motor shall be totally enclosed fan cooled induction motor of required H.P. The motor shall be suitable for 400/ 440 volts, 3 phases, 50 cycles A.C. power supply and shall be with IP44 protection.

**Pressure Gauge**

Each pumping set shall be provided with a 150 mm dia gunmetal “Bourden” type pressure gauge with gunmetal isolation cock and connecting piping.

**Vibration pads**

Provide vibration-eliminating pads appropriate for each pump.

11. **Sewage/drainage sump pumps**

Sewage sump pumps shall be fully submersible suitable for raw sewage, muddy water and solids up to 25 mm size. Pumps shall be wet pit type, grease lubricated and having ample support arrangement for suspension from sump top slab. Impeller shall be cast iron with open vanes. Pumps shall operate with high water level in sump and stop at low water level by means of an electronic level controller.

12. **Vibration eliminators**

Provide on all suction and delivery lines double-flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump.
and tested to the test pressure given in the relevant head. Length of the connector shall be as per manufactures details.

13. Cables

Contractor shall provide all power and control cables from the motor control center to various motors. Cables shall conform to I. S. 1554 and carry ISI mark. Writing cables shall conform to IS 694. All power and wiring cables shall be aluminium conductor PVC insulated armoured and PVC sheathed of 1100 volts grade. All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 volt grade. All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer’s name. All cable joints shall be made in an approved manner as per standard practice.

14. Cables trays

Contractor shall provide M.S. slotted cables trays at locations as shown on the drawings and of sizes as given in the schedule of quantities. Cables trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by welding support rods with insert plates or to reinforcement bars. Cutting of holes in the slab for exposing of reinforcement bars and making good the same after welding of support rids shall be included in the rate or the tray and no separate payment shall be made on this account. Cost of clips, bolts, nuts, supports rods and any other materials required to fix the trays in proper manner shall be included in the rate for trays.

15. Earthing

All equipment installed by the contractor shall be suitably earthed by making proper connection by means of G.I.. Wires to the main earthing system laid by the electrical contractors.

16. Motor control center

Switchboard cubicles of approved type shall be fabricated from 14 gauge M. S. sheet with dust and vermin proof construction. It shall be powder coated with 7 tank process of approved shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following:- (switchgear as given in the schedule of quantities).

a) Incoming main TPN MCCB of required capacity.
b) Isolation MCCB/MCB, one for each motor.
c) Fully automatic DOL/ star delta starter suitable for motor H.P. with push buttons one for each motor and on / off indicating neon lamps.
d) Single phasing preventer of appropriate rating for each motor.
e) Rotary duty selector switch.
f) Panel type ampere meters on incoming main with ampere selector switch.
g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase-to-phase.

h) Neon phase indicating lamps on the incoming main.

i) Rotary switch for manual or auto operation for each pump.

j) Fully taped aluminium bus bars of required capacity.

The panel shall be pre-wired with colour-coded wiring. All switchgears and accessories shall be approved make such as “Larsen and Toubro” or equivalent. Switchboard cubicle shall be floor or wall mounted type as recommended by manufacturers.

17. Measurements

Sanitary fixtures shall be measured by numbers an inclusive of all items as specified in schedule of quantities

a) All, uPVC, CI, GI, CI’LA’ soil, waste, vent, antisiphonage and rain water pipes shall be measured net when fixed correct to a centimetre including all fittings along its lengths. No allowance shall be made for the portion of pipe lengths entering the sockets of the adjacent pipes or fittings. No extra payment is made for any clamp, hanger, slotted angle, channel, nuts, and bolts.

b) Measurement for excavation of pipe trenches shall be made per cum. For all class of soil. No extra payment shall be made for timbering, shoring, refilling, consolidation, disposal of extra earth within a lead of 200m, stepping (excavation in steps), pumping and bailing out water in saturated soil, pumping out surface water from rain falls or broken pipes etc.

c) Stoneware pipes/RCC pipes shall be measured for the finished length of pipeline per linear meter i.e. length between manhole shall be recorded from inside of one manhole to inside of other manhole.

d) All manholes shall be measured by numbers and shall include all items specified above and necessary excavation, refilling & disposal of surplus earth.

e) Manhole with depths greater than specified under the main item shall be paid for under extra depth and shall include all items as given for manholes, measurement shall be done to a nearest cm. Depth of the manholes shall be measured from top of the manhole cover to the bottom of channel.

f) GI pipes below ground shall be measured per linear metre (to nearest cm) and shall be inclusive of, fittings, e.g. couplings, tees, bends, elbows, unions, and deduction for valve shall be made. Rates quoted shall be inclusive of all fittings, excavation, refilling and disposal of surplus earth, cutting holes and chases and making good and all other items mentioned in the specification and schedule of quantities.
**LIST OF STANDARD CODES**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>IS Code No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IS:1729:1979</td>
<td>Specification for sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories (1st rev.) (Amendment 4)</td>
</tr>
<tr>
<td>2.</td>
<td>IS:651:1992</td>
<td>Specification for salt glazed stoneware pipes and fittings (5th rev.) (Amendment 1)</td>
</tr>
<tr>
<td>8.</td>
<td>IS:780:1984</td>
<td>Specification for sluice valve for water works purposes (6th rev.) (50 to 300 mm size) (amendment 3)</td>
</tr>
<tr>
<td>9.</td>
<td>IS:1172:1993</td>
<td>Code of basic requirements for water supply, drainage &amp; sanitation (4th rev.)</td>
</tr>
<tr>
<td>14.</td>
<td>IS:5312 (part 1):1984</td>
<td>Swing heck type reflux valves (non-return valve): part 1 single door pattern (1st rev.)(Amendment 1)</td>
</tr>
<tr>
<td>15.</td>
<td>IS:1726:1991</td>
<td>CI manhole covers &amp; frames (3rd rev.)</td>
</tr>
<tr>
<td>S.No.</td>
<td>IS Code No.</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------</td>
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</tr>
<tr>
<td>16.</td>
<td>IS:884:1985</td>
<td>Fire aid hose reel for fire fighting</td>
</tr>
<tr>
<td>17.</td>
<td>IS:901:1988</td>
<td>Coupling double male and female instantaneous pattern for fire fighting</td>
</tr>
<tr>
<td>18.</td>
<td>IS:903:1984</td>
<td>Fire hose delivery coupling, branch pipe, nozzles and nozzles spanner</td>
</tr>
<tr>
<td>19.</td>
<td>NBC-SP-7-1983 Part IV</td>
<td>National building code of India 1983, amendment No. 3</td>
</tr>
<tr>
<td>20.</td>
<td></td>
<td>Central public works division (CPWD) Part-V, wet riser system for fire fighting 1985, Govt. of India</td>
</tr>
<tr>
<td>21.</td>
<td>IS:3844-1989</td>
<td>Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises</td>
</tr>
<tr>
<td>24.</td>
<td>IS:6382:1984</td>
<td>Code of practice for design and installation of fixed system carbon dioxide fire extinguishing system</td>
</tr>
<tr>
<td>25.</td>
<td>SP:35 (s&amp;t)-1987</td>
<td>Hand book on water supply &amp; drainage by bureau of Indian standards</td>
</tr>
<tr>
<td>26.</td>
<td></td>
<td>National Building code (sec-ix)</td>
</tr>
<tr>
<td>27.</td>
<td>IS:2065:1983</td>
<td>Code of practice for water supply in buildings</td>
</tr>
<tr>
<td>28.</td>
<td>IS:5290-1983</td>
<td>Specifications for landing valve</td>
</tr>
<tr>
<td>29.</td>
<td>IS:933-1989</td>
<td>Specifications for portable chemical from fire extinguisher</td>
</tr>
<tr>
<td>30.</td>
<td>IS:2171-1985</td>
<td>Specifications for portable fire extinguishers, dry power</td>
</tr>
</tbody>
</table>
# LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS PLUMBING

<table>
<thead>
<tr>
<th>S.No</th>
<th>Item</th>
<th>Make at PAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Vitreous China Sanitary ware</td>
<td>BOLAN/ROCA/PARRYWARE/ HINDWARE/Kohler</td>
</tr>
<tr>
<td>2.</td>
<td>Concealed Cistern</td>
<td>BOLAN/VIEGA/ GEBRIT</td>
</tr>
<tr>
<td>4.</td>
<td>Stainless Steel Sinks</td>
<td>JAYNA/ STAR</td>
</tr>
<tr>
<td>5.</td>
<td>C.P. Fittings &amp; Accessories</td>
<td>BOLAN/ISENBERG/ JAQUAR / Grohe</td>
</tr>
<tr>
<td>6.</td>
<td>Rubber Insulation</td>
<td>ARMAFLEX/ VIDEOFLEX</td>
</tr>
<tr>
<td>7.</td>
<td>CPVC pipes/fittings and valves</td>
<td>FLOWLIFE/ASTRAL/ ASHIRWAD/ Supreme</td>
</tr>
<tr>
<td>8.</td>
<td>G.I. Pipes /M.S.Pipes IS 1239/3589</td>
<td>JINDAL HISSAR/PRAKASH SURYA</td>
</tr>
<tr>
<td>9.</td>
<td>G.I. Fittings (Malleable cast iron)</td>
<td>DRP-M/UNIK / SFMC/SINTEX/DIPLAST</td>
</tr>
<tr>
<td></td>
<td>Soil, Waste &amp; Rain water pipes &amp; Fittings –</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>CAST IRON (IS: 3989)</td>
<td>SKF/NECO</td>
</tr>
<tr>
<td>12.</td>
<td>S.S. Hinged Grating</td>
<td>GMGR/ CHILLY</td>
</tr>
<tr>
<td>13.</td>
<td>Check Valves (Dual Slim type)</td>
<td>VEESON /SANT/KARTAR</td>
</tr>
<tr>
<td>14.</td>
<td>Butterfly Valve</td>
<td>VEESON /AIP/KARTAR/ZOLOOTO</td>
</tr>
<tr>
<td>15.</td>
<td>Ball valves (15 to 40mm)</td>
<td>DRP/ KARTAR / ZOLOOTO</td>
</tr>
<tr>
<td>16.</td>
<td>Gate Valve</td>
<td>DRP/ AIP/KARTAR/ZOLOOTO</td>
</tr>
<tr>
<td>17.</td>
<td>Gunmetal valve (full way valve) Class-I</td>
<td>DRP/ LEADER/ZOLOOTO</td>
</tr>
<tr>
<td>18.</td>
<td>C.I. double flanged sluice valve</td>
<td>KIRLOSKAR/ SHIVA-DURGA</td>
</tr>
<tr>
<td>19.</td>
<td>Diaphragm Valve</td>
<td>As approved by water treatment manufacturer’s</td>
</tr>
<tr>
<td>20.</td>
<td>Foot Valve</td>
<td>DRP/ KIRLOSKAR/KARTAR</td>
</tr>
<tr>
<td>21.</td>
<td>Pressure Reducing Valve (PRVs)</td>
<td>DRP/ZOLOTO/KATAR</td>
</tr>
<tr>
<td>22.</td>
<td>Stoneware Pipes &amp; Gully - IS 651</td>
<td>Locally ISI approved</td>
</tr>
<tr>
<td>23.</td>
<td>RCC Pipes IS 458</td>
<td>Locally ISI approved</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Brand/Model</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>24</td>
<td>C.I. Manhole cover &amp; frame IS 1726</td>
<td>SKF/RIF</td>
</tr>
<tr>
<td>25</td>
<td>SFRC Manhole COVERS ETC</td>
<td>KK/PRAGATI/SUPER WIRE/ISI</td>
</tr>
<tr>
<td>26</td>
<td>Anti corrosive tape for pipe protection</td>
<td>PYPKOTE/MAKPOLYKOTE</td>
</tr>
<tr>
<td>28</td>
<td>Garden Irrigation System</td>
<td>JAIN/HARVEL</td>
</tr>
<tr>
<td>29</td>
<td>Anticorrosive Bitumastic Paint</td>
<td>ISI</td>
</tr>
<tr>
<td>30</td>
<td>Epoxy Paint</td>
<td>ISI</td>
</tr>
<tr>
<td>31</td>
<td>Hydro-Pneumatic System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pumps</td>
<td>DP-HOLAND/GRUNDFOSS/WILLO</td>
</tr>
<tr>
<td></td>
<td>PLC</td>
<td>AS PER MANUFACTURERS SPEC'S</td>
</tr>
<tr>
<td></td>
<td>Pressure Vessel</td>
<td>AS PER MANUFACTURERS SPEC'S</td>
</tr>
<tr>
<td></td>
<td>Pressure Sensor</td>
<td>AS PER MANUFACTURERS SPEC'S</td>
</tr>
<tr>
<td>32</td>
<td>Clear Water Pumps</td>
<td>DP-HOLAND/GRUNDFOSS/WILLO</td>
</tr>
<tr>
<td>33</td>
<td>Submersible Drainage Pumps</td>
<td>DP-HOLAND/GRUNDFOSS/EBARA/WILLO/KSB</td>
</tr>
<tr>
<td>34</td>
<td>Filter/Softener</td>
<td>BRISANZIA /ION EXCHANGE/PENTAIR</td>
</tr>
<tr>
<td>35</td>
<td>PH Meter</td>
<td>VATS/ HANNA (italy)</td>
</tr>
<tr>
<td>36</td>
<td>Water Meter</td>
<td>kaycee/ kent</td>
</tr>
<tr>
<td>37</td>
<td>Electrical Switchgear &amp; Starters</td>
<td>L&amp;T OR EQUIVALENT</td>
</tr>
<tr>
<td>38</td>
<td>Cable Trays</td>
<td>SLOTCO OR EQUIVALENT</td>
</tr>
<tr>
<td>39</td>
<td>1100 Volt Grade XLPE Cables</td>
<td>ISI</td>
</tr>
<tr>
<td>40</td>
<td>PVC Insulated Copper Wires</td>
<td>ISI</td>
</tr>
<tr>
<td>41</td>
<td>Lugs (Tinned Copper)</td>
<td>EQUIVALENT</td>
</tr>
<tr>
<td>42</td>
<td>Power Aux. Contactors</td>
<td>EQUIVALENT</td>
</tr>
<tr>
<td>43</td>
<td>Vibration Eliminator Pads &amp; Connections</td>
<td>RESISTOFLEX</td>
</tr>
<tr>
<td>44</td>
<td>Suction Strainer/Pot Strainer</td>
<td>VENUS/LEADER/EMARALD/ZOLOTO</td>
</tr>
<tr>
<td>45</td>
<td>Meters, Indication Lamp</td>
<td>ENERCON OR EQUIVALENT</td>
</tr>
<tr>
<td>46</td>
<td>Forged Steel Fittings</td>
<td>DRP /VS</td>
</tr>
</tbody>
</table>
### Combined Technical Specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Brand/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>47.</td>
<td>Pressure Gauge</td>
<td>FIEBIG/GURU</td>
</tr>
<tr>
<td>48.</td>
<td>Measuring Instruments</td>
<td>EQUIVALENT</td>
</tr>
<tr>
<td>49.</td>
<td>Electrical Panels</td>
<td>IMPACT ENGINEERS/ELEGANT</td>
</tr>
<tr>
<td>50.</td>
<td>Air Admittance valves</td>
<td>STUDOR/McALPINE</td>
</tr>
<tr>
<td>51.</td>
<td>Automatic Air Vent</td>
<td>DANFOSS/ IBP</td>
</tr>
<tr>
<td>52.</td>
<td>Water level indicator &amp; controller</td>
<td>ITAL/ TECHNIKA</td>
</tr>
<tr>
<td>53.</td>
<td>Pipe Clamps / Hangers / Support</td>
<td>CAMRY/ CHILLY</td>
</tr>
<tr>
<td>54.</td>
<td>Clamps &amp; Support</td>
<td>CAMRY/ CHILLY</td>
</tr>
<tr>
<td>55.</td>
<td>Paint</td>
<td>Shalimar/ Asian</td>
</tr>
<tr>
<td>56.</td>
<td>PPR Gate Valves (20MM to 160MM)</td>
<td>SFMC, Reliance, Supreme</td>
</tr>
<tr>
<td>57.</td>
<td>PPR Ball Valve (20MM to 160MM)</td>
<td>SFMC, Reliance, Supreme</td>
</tr>
<tr>
<td>58.</td>
<td>Water Tanks</td>
<td>SFMC, Sintex, Diplast</td>
</tr>
<tr>
<td>59.</td>
<td>PPR Pipes (3 layer) &amp; Fittings &amp; Valves</td>
<td>SFMC, Reliance, Supreme</td>
</tr>
</tbody>
</table>

**Note**

1. In respect of materials for which approved makes are not specified above, the same shall be decided by the GM, NBCC or his representative and shall be as per sample got approved from GM, NBCC and consulting Architect before procurement. The Contractor shall submit samples of all such materials 3 months before the date of start of such work for approval from the GM, NBCC or his appointed representative through consulting Architect.

2. The Contractor shall produce samples before procurement of the material for approval for all materials required for works. Samples can be submitted from any of the above makes and they shall confirm to specifications. Samples as approved by the GM, NBCC shall only be used on the works and the decision of the GM, NBCC or his appointed representative regarding make of material shall be final. Only ISI marked will be allowed to use on works.

3. In case material bearing BIS/ ISI certification mark are not available, the quality of material shall be judged by standard laid down in the relevant BIS/ ISI specification for which make / brand shall be got approved from GM, NBCC or his appointed representative.
TECHNICAL SPECIFICATIONS
FOR
INTERNAL ELECTRICAL WORK
1.0 WIRING:

1.1 Scope:

1.1.1 The scope of this section covers the supply, erection, testing and commissioning of conduits & wiring for lighting and power. Wiring shall be carried out in accordance with relevant I.S. rules and regulations.

1.2 System of wiring:

1.2.1 All lights and power wiring shall be carried out in surface conduits or recess wiring in conduits or floor ducts as specified.

1.2.2 I.E.E. regulations shall be applicable for all material and workmanship.

1.2.3 The wiring to be carried out in such a manner that specified 'Power' wiring shall be kept separate and distinct from 'Lighting' wiring. The wiring shall be done on the distribution system with main and branch distribution boards at convenient physical and electrical centers as shown in drawings. All conductors shall be run as far as possible along the walls and ceiling and above false ceiling so as it can be easily accessible and capable of being thoroughly inspected. In all types of wiring, due consideration shall be given for neatness and good appearance.

1.2.4 The balancing of load in three wire or poly phases installations shall be arranged before hand to the satisfaction of Engineer-in-charge. In large or important areas, light and socket outlet points shall be distributed over more than one circuit as directed.

1.2.5 Medium pressure wiring and associated apparatus shall comply in all respects with the requirements of IEE rules.

1.2.6 No wiring shall be carried out until the appropriate tests required in Section "Inspection and Testing" have been done and the Engineer-in-Charge has given his clearance for wiring to commence.

1.2.7 At expansion joints, adequate slack shall be left in the cables.
1.2.8 Where conduits are installed for wiring by others, a draw wire shall be provided between each draw-in position.

1.2.9 Cables forming part of communication circuits shall have identification sleeves at their terminations. Identification shall be consistent with the relevant wiring diagrams.

1.3 **Joints & Looping Back:**

1.3.1 The wiring shall be done in a 'looping System'. Phase or live conductors shall be looped at the switch box and neutral conductor can be looped either from the light, fan or socket outlet.

1.3.2 No bare or twist joints shall be made at intermediate points in the through run of cables, unless the length of final sub circuit or sub-main or main is more than the length of the standard coil given by the manufacturer of the cable.

1.3.3 Termination of multistrand conductors shall be done using suitable crimpling type thimbles.

1.4 **PVC Conduit and Conduit Accessories:**

1.4.1 All non-metallic conduit pipes and accessories shall be of suitable material complying with IS:2509-1973 and IS:3419-1976 for rigid conduits and IS:6946-1973 for flexible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked.

1.4.2 The conduits shall be circular in cross-section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non-metallic conduits are given in Table-III.

1.4.3 No non-metallic conduit less than 20 mm in diameter shall be used.

1.4.4 The conduit wiring system shall be complete in all respect including accessories.

1.4.5 Rigid conduit accessories shall be normally of grip type.

1.4.6 Flexible conduit accessories shall be of threaded type.

1.4.7 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.

1.4.8 Saddles for fixing conduits shall be heavy gauge non-metallic type with base.

1.4.9 The maximum number of PVC insulated cables conforming to IS: 694-1990 that can be drawn in one conduit is given size wise in Table-1. And the number of cables per conduit shall be exceeded. Conduit sizes shall be selected accordingly in each run.

1.4.10 The erection of conduits of each sections shall be completed before the cables are drawn in.

1.5 **Installation-Common aspects for both recessed and surface conduit works:**

1.5.1 **Conduit Joints**

(i) All joints shall be sealed/cemented with approved cement. Damaged conduit pipes/ fittings shall not be used in the work. Cut ends of conduit pipes shall have no sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes.
(ii) The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.

1.5.2 Bends in Conduit

(i) All bends in the system may be formed either by bending the pipes by an approved method of heating, or by inserting suitable accessories such as bends, elbows or similar fittings, or by fixing non-metallic inspection boxes, whichever is most suitable. Where necessary, solid type fittings shall be used.

(ii) 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.

(iii) 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.

1.6 Installation-Additional requirements for surface conduit work

(i) Conduit pipes shall be fixed by heavy gauge non-metallic saddles with base, secured to suitable approved plugs with screws in an approved manner, at an interval of not more than 60 cm, but on either side of couplers or bends or similar fittings, saddles shall be fixed at a closer distance from the centre of such fittings. Slotted PVC saddles may also be used where the PVC pipe can be pushed in through the slots. The minimum width and thickness of the ordinary clips or the girder clips for different sizes of conduits shall be as given in Table-II.

(ii) Where the conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips as required by the Engineer-in-charge. Where it is not possible to use these for fixing, suitable clamps with bolts and nuts shall be used.

(iii) If the conduit pipes are liable to mechanical damage, they shall be adequately protected.

1.7 Installation-Additional requirements for recessed conduit work

1.7.1 Make Chase

(i) The chase in the wall shall be neatly made, and of ample dimensions to permit the conduit to be fixed in the manner desired.

(ii) In the case of buildings under construction, the conduits shall be buried in the wall before plastering, and shall be finished neatly after erection of conduit.

(iii) In case of exposed brick / rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

1.7.2 Fixing Conduit in Chase

(i) The conduit pipe shall be fixed by means of staples, or by means of non-metallic saddles, placed at not more than 60 cm apart, or shall be fixed by any other approved means of fixing.

(ii) At either side of the bends, saddles/staples shall be fixed at a distance of 15 cm from the centre of the bends.

1.7.3 Erection in RCC work
(i) The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent taming of the same.

(ii) Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius which will permit easy drawing in of conductors.

(iii) Location of inspection/ junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

1.7.4 Fixing of Inspection Boxes

(i) Suitable inspection boxes to the minimum requirement shall be provided to permit inspection, and to facilitate replacement of wires, if necessary.

(ii) These shall be mounted flush with the wall or ceiling concrete. Minimum 65 mm depth junction boxes shall be used in roof slabs and the depth of the boxes in other places shall be per IS: 2667-1977.

(iii) Suitable ventilating holes shall be provided in the inspection box covers if directed.

1.8 Routes and Segregation:

1.8.1 In case the routes of conduit and ducting are not shown on the drawings, they shall be determined by the Contractor and approved by Engineer-in-Charge before work is started. This requirement shall apply where the conduit or duct is concealed within the building fabric as well as where they are on the surface.

1.8.2 Conduit and ducting shall be parallel with lines of building construction and properly aligned except where conduit is permitted in floor screeds. Conduit buried in wall finishes shall run vertically only, unless Engineer-in-Charge gives approval to deviate from this requirement.

1.8.3 A minimum clearance of 150 mm between conduits shall be allowed from any equipment/ Low current services conduit like Telephone/Computer/CCTV/ pipe work or duct work. Distance shall be measured from the external surface of any lagging. In event of difficulty in achieving this requirement, Engineer-in-Charge shall be informed.

1.9 Wires:

1.9.1 The type and size of wires shall be as indicated in the BOQ / Drawings. All the material supplied and used by the contractor shall be new. Wires shall have copper conductors unless otherwise specified, and the size shall be as per IS standards unless specified.

1.9.2 All wires shall comply with relevant IS. Type of wire to be used shall be as specified in the BOQ / Drawings.

1.9.3 The colour identification of wires shall comply with the IEE wiring regulations for all category of circuits. Core identification colors shall extend throughout the length of PVC insulated
wires. Core identification for sound distribution or public address systems shall be in grey colour.

1.9.4 Wires shall be protected throughout their length by trunking, ducting, conduit and equipment enclosures. Framework or partitions may be used, but only where indicated or with the approval of Engineer-in-Charge.

1.9.5 Wires carrying direct current may, if desired, be bunched whatever their polarity, but wires carrying alternating current, if installed in metal conduit shall always be bunched so that the outgoing and return wires are drawn into the same conduit.

1.9.6 Where the distribution is for single phase loads only, conductors for these phases shall be drawn in one conduit.

1.9.7 In case of three phase loads, separate conduits for separate phase shall be run from the distribution boards to the load points, or outlets as the case may be.

1.9.8 Wires shall comply with relevant IS for LV & ELV circuits.

1.9.9 Where conduits cross expansion and settlement joints in the building structure, suitable provision shall be made to allow for movement of the structure. The Contractor shall submit his proposals for the approval of the Engineer-in-Charge.

1.9.10 Conduits entering voids shall terminate not less than 22 mm clear of the building fabric. Open ends of conduit shall be temporarily plugged immediately after they are installed to prevent ingress of water and solid materials.

1.9.11 Where wires pass through joints, the number and size of holes shall allow for easy withdrawal and replacement of cables. The diameter of holes shall not exceed 1/6th the depth of the joints. They shall be approximately on the centre line and shall be not less than 75 mm between centres. Joints shall not be notched.

1.9.12 The method to be used for forming fire barriers at fire resistant structural elements such as floors and walls shall be submitted for the Engineer-in-Charge's approval.

1.9.13 Where wires enter a metal enclosure, they shall be protected by grommets or secured by wires clamps.

1.9.14 Wires shall be looped between outlet points and as far as practicable, intermediate joints shall not be used.

1.9.15 Wires fixed to the surface, except in ducts, shall be protected up to a height of 1500 mm by high impact PVC channel.

1.9.16 Wires shall have identification sleeves at their terminations.

1.9.17 Identification shall be consistent with the relevant wiring diagrams.

1.10 Modular Switches:

1.10.1 Switches shall be single pole unless otherwise indicated. Their current ratings shall be as indicated, allowance being made for any inductive or capacitive load.
1.10.2 Wall mounted switches located inside buildings shall have rocker type actuating members unless otherwise indicated. Where mounted adjacent to one another, they shall be grouped in a multi gang box with a common front plate.

1.10.3 Pull cord operated switches shall be fixed to white moulded plastic mounting blocks, which in turn shall be fixed to a circular conduit box. Where the conduit boxes are flush with the finish, mounting block shall overlap them. Pull cords shall be white or natural colour and the lower end shall terminate in a moulding of rubber or plastic material.

1.11 **Modular Socket Outlets:**

1.11.1 Socket outlets shall be of modular type and rating as indicated. Pilot contacts shall be provided where indicated.

1.11.2 Socket outlets shall be switched where indicated. On socket outlets rated at 16A and located inside buildings, the switches shall be single pole and have rocker type actuating members unless otherwise indicated.

1.11.3 Socket outlets for wet locations shall be provided with covers, which shall be screwed on. Any cover required to achieve total enclosure and to ensure the required degree of protection against moisture shall be securely fixed to socket outlet.

1.11.4 Sockets/ Telephone/ Computer/ CCTV/ Socket outlets shall be of the type as mentioned in the BOQ.

1.12 **Plugs:**

1.12.1 ISI marked Plugs shall be provided as indicated. Plug bodies shall be of metal, plastic or other material as indicated.

1.12.2 Plugs rated at 16A shall be of a non-resilient material unless otherwise indicated.

1.13 **Terminal Blocks:**

1.13.1 Conductors shall be clamped between metal surface and no screws shall make direct contact with conductors.

1.13.2 The design shall be such as to maintain sufficient contact pressure to ensure connections on negligible impedance at all times.

1.13.3 Metal in contact with conductors shall be 85% copper alloy and any screws shall be of metal that is electrolytic ally compatible with the copper alloy. The moulded housing shall be an insulating material suitable for the maximum operating temperature of the conductor.

1.14 **Mounting Heights:**

1.14.1 Mounting heights shall be as follows unless otherwise indicated in the drawings, where decision shall be obtained by contractor before start of work.

<table>
<thead>
<tr>
<th>MOUNTING HEIGHTS (for accessories and equipment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bracket Light</td>
</tr>
</tbody>
</table>

ENARCH CONSULTANTS Pvt. Ltd.
2. Mirror light 1800mm
3. Switch board 1050mm
4. 5/15A light/power sockets 625mm
5. 5/15A switch for sockets 625mm
6. D Bs 1500mm
7. 15A socket in toilet 1800mm
8. 15A switch in toilet 1050mm
9. 15/5A power points in Pantry 150mm above cooking slab
10. Computer/Telephone outlet. 625mm

NOTES:
1. Heights are from finished floor level to the center of the accessory or equipment, except in the case of worktops when the measurement shall be from the worktop surface.
2. If the specified height of an accessory coincides with the top of tiling, the accessory shall be mounted above the tiling, leaving a clear gap of 50 mm.
3. Where apparatus is located underneath a worktop, the accessory shall be mounted 100 mm below the underside of the worktop.

1.14.2 Where difficulty in locating accessories or equipment occurs the Engineer-in-Charge shall be informed.

1.15 Supports And Fixings:
1.15.1 Support shall be positioned with in 300 mm of each bend and conduit box. Conduit boxes shall be fixed to fabric of building independent of the conduit. Where the conduit boxes have a minimum degree of protection of IP44, the fixing shall not reduce that protection.
1.15.2 Conduits shall be fixed in accordance with under mentioned Table. No shot firing shall be used and no drilling or welding of structural steel work shall be done without the approval of Engineer-in-Charge.

**TABLE CONDUIT FIXING**

<table>
<thead>
<tr>
<th>Location</th>
<th>Type of fixing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor screeds</td>
<td>Saddles</td>
</tr>
<tr>
<td>Buried in plaster</td>
<td>Crampets or saddles</td>
</tr>
<tr>
<td>Or render</td>
<td>Spacer bar saddles</td>
</tr>
<tr>
<td>Above false ceilings</td>
<td></td>
</tr>
</tbody>
</table>
Surface Distance Saddles

2. Fixing of Saddles, Conduit Boxes

<table>
<thead>
<tr>
<th>Building Fabric</th>
<th>Type of fixing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural steelwork</td>
<td>Purpose made clamps</td>
</tr>
<tr>
<td></td>
<td>(Type to be approved by Engineer-in-Charge)</td>
</tr>
<tr>
<td>Non-Structural steelwork</td>
<td>Sets screws and nuts</td>
</tr>
<tr>
<td>Concrete, brick or Blocks</td>
<td>Fiber plugs &amp; screws</td>
</tr>
<tr>
<td>Hollow blocks &amp; pot</td>
<td>Butterfly spring toggle bolts</td>
</tr>
<tr>
<td>Floors</td>
<td>or gravity bolts</td>
</tr>
<tr>
<td>Timber</td>
<td>Wood screws</td>
</tr>
</tbody>
</table>

1.15.3 Screws and nuts shall be cadmium or zinc electroplated or passivated.

1.16 Protective Conductor:

1.16.1 Protective conductor shall be drawn through ducting and non-screwed metallic conduit.

1.16.2 Where live conductors terminate at or loop into terminals adjacent to an appliance or accessory, the protective conductor shall be terminated. Properly using earth studs, earth terminal block etc. so the case may be.

1.16.3 A protective conductor shall be installed within each length of steel conduit and connected to an earthing terminal at each end of the conduit.

1.17 Outlet Boxes

1.17.1 16 SWG MS/G.I. boxes of the required sizes shall be provided to house the Switch/sockets/Telephone/TV/Computer outlets as may be required/ mentioned in BOQ. These shall be so designed that there is ample space at the rear and at the sides to accommodate conductors at the conduit entries. These shall be completely concealed leaving edges flush with wall surface unless mentioned otherwise.

1.18 Draw Boxes/ Inspection Boxes

1.18.1 16 SWG Mild Steel/GI draw/inspection boxes of adequate dimensions minimum size 75 mm x 75 mm shall be provided at convenient points on walls to facilitate long runs of conductors. They will be completely concealed with 3 mm Perspex/ hylam covers flush with plate work. These boxes will, as far as possible, be located where found suitable by the Engineer-in-Charge.

1.19 Protection of Conduits

1.19.1 To safeguard against filling up with plaster etc. all the outlet and switch boxes will be provided with temporary covers and plugs within the tendered cost which shall be replaced
by sheet / plate covers as required. All screwed and socketed joints shall be made fully water tight by the use of white lead for steel conduits.

1.20 Cleaning of Conduit Runs

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

1.21 Laying Of Dummy Conduit

1.21.1 The dummy conduits shall be the same as conduits for Electrical work and as specified before. The minimum size shall be 20 mm dia. Junction boxes shall be provided at distance not exceeding 10 m. The Contractor must make such modifications as the system designer / manufacturer desires in consultation with the Owners / Architects. These conduits shall be provided with steel draw boxes of at least 14 SWG.

1.22 Fish Wires

1.22.1 To facilitate drawing of wiring through conduits/ G.I / Steel pipes etc., G.I. fish wire of 14 SWG, wherever needed, shall be provided along with recessed conduit / pipes, without any extra cost.

| Table –I |
| Maximum number of PVC insulated 650/1100 V Grade Aluminum/Copper conductor cable conforming to IS:694/1990 |

<table>
<thead>
<tr>
<th>Nominal Cross sectional area of cond. in sq. mm</th>
<th>20mm</th>
<th>25mm</th>
<th>32mm</th>
<th>38mm</th>
<th>51mm</th>
<th>64mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>1.5</td>
<td>5</td>
<td>4</td>
<td>10</td>
<td>8</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>2.5</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>-</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>-</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

ENARCH CONSULTANTS Pvt. Ltd.
### NOTE:
1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cable.

2. The columns headed ‘S’ apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed ‘B’ apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3. Conduit sizes are the nominal external diameters.

#### TABLE-III

**Dimensional details of rigid non-metallic conduits.** *(All dimensions in mm)*

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Nominal Outside Diameter (in mm.)</th>
<th>Maximum Outside Diameter (in mm.)</th>
<th>Minimum Inside Diameter (in mm.)</th>
<th>Maximum Permissible Eccentricity (in mm.)</th>
<th>Maximum Permissible Quality (in mm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>20+0.3</td>
<td>17.2</td>
<td>0.2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

---

**TABLE-II**

**Girder Clips or Clamps**

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>Size of conduit</th>
<th>Width</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20 mm</td>
<td>19 mm</td>
<td>0.9mm (20 SWG)</td>
</tr>
<tr>
<td>2</td>
<td>25 mm</td>
<td>19 mm</td>
<td>0.9mm (20 SWG)</td>
</tr>
<tr>
<td>3</td>
<td>32 mm &amp; above</td>
<td>25 mm</td>
<td>1.2mm (18 SWG)</td>
</tr>
</tbody>
</table>
2.0 MCB DISTRIBUTION BOARDS:

2.1 Scope:
2.1.1 The scope of this section covers Supply, installation, testing and commissioning of Miniature circuit breaker boards and Miniature Circuit breakers. Miniature circuit breaker boards shall comply with BS 5486 part 12 a clause 3.2 and 3.3. They shall have a fault withstand classification of class 1 unless otherwise indicated.

2.2 MCB Distribution Boards
2.2.1 These distribution boards shall be used for control of all lighting/power circuits and shall consist of single pole/ single/ double/TP & N/ triple/four pole miniature circuit breakers mounted in double cover design, dust tight, heavy gauge sheet steel enclosures preferably zinc coated with powder coating finish.

2.2.2 Distribution Boards shall be flush or surface pattern according to the requirements of their location and shall incorporate isolators/MCB and circuit switches as specified in bill of quantities.

2.2.3 All MCBs shall be connected to the electrolytic copper bus bars with direct bolted connections.

2.2.4 Earthing bar and neutral bars shall be provided having sufficient ways to enable each cable to be connected to a separate terminal. Neutral connections shall be corresponding in position to phase connections.

2.2.5 Distribution boards shall have phase barriers and PVC ducts for all interior wiring. All distribution boards shall have removable end plates at top and bottom and handles with provision for locking.

2.2.6 Phase barriers shall be provided in the 3-phase distribution Boards.

2.2.7 In TP&N distribution boards, neutral bus bars shall have one outgoing terminal for each outgoing circuit.

2.2.8 Size of SDB shall be selected to cater to extra space on the bus for mounting ELCBs in addition to number of outgoing MCBs specified in the BOQ / Drawings.

2.2.9 A multi-terminal bar for the circuit protective conductors shall be provided for both insulated and metal cased boards, with one terminal for each outgoing circuit. It shall be directly connected to the earthing terminal without dependence on the exposed conductive parts of the enclosure.

2.2.10 Identification of each MCB way shall be by numbering. Identification in the neutral bus bar and protective conductor bar shall clearly relate each terminal to its respective MCB way.
2.2.11 Spare MCB ways shall be provided as indicated in BOQ / Drawings. Where specific ratings are indicated, MCB shall be incorporated otherwise the ways shall be left blank but suitable for future additions. Suitable number of blanking plates shall be fixed in the DB if the space for MCB is left blank.

2.2.12 A separate Junction box of min. height of 150 mm shall be provided for extra lengths of outgoing circuit wires on Top/Bottom (as required) to avoid jumbling of wires within the main section of SDB. The junction box will be properly earthed along with the SDB.

2.3 **Miniature Circuit Breakers**

2.3.1 Miniature circuit breakers shall be designed and tested strictly in accordance with the relevant parts of Indian standards and shall consist of spring accelerated quick-make and quick break action mechanism fitted in moulded cases of high di-electric strength plastic or urea. Fixed and moving contacts shall have silver tungsten contacts.

2.3.2 Miniature circuit breakers used shall be of “B” Series for Normal lighting circuits and Normal Power/Geyser Loads. For AC loads, Tungsten lamps fittings, Sodium/Mercury Discharge lamps “C” Series shall be used unless otherwise mentioned.

2.3.3 Miniature circuit breakers shall have a minimum breaking capacity of 10 KA at 415 V.

2.4 **ELCBs**

2.4.1 ELCBs shall be designed and tested strictly in accordance with the relevant parts of Indian standards. Fixed and moving contacts shall have silver tungsten contacts.

2.4.2 ELCBs used shall be of Rating and sensitivity as specified in the BOQ.

2.4.3 ELCBs shall have a breaking capacity of 10 KA at 415 V and shall be ordinarily be for Earth Leakage protection unless mentioned otherwise.

3.0 **LUMINAIRES AND LAMPS:**

3.1 **Scope:**

3.1.1 The scope of this section comprises of Supply, erection, testing and commissioning of lighting fixtures for internal lighting wherever required of the specified models as per IS:3646 (part-I) 1992 for interior lighting.

3.1.2 Without restricting to the generality of the foregoing, this section shall include luminaires, lamps and accessories necessary and required for the installation.

3.1.3 Whether specifically mentioned or not, the luminaires and lamps shall be provided with all fixing devices, terminal blocks, holders etc. as required.

3.2 **General Requirements:**

3.2.1 All the luminaires and lamps shall be of best quality and as per approved makes. Wherever alternative makes are specified the choice of selection shall remain with the Engineer-in-Charge.

3.2.2 The luminaries and lamps shall be fixed in a neat work man like manner, true to level and in accordance with manufacturer's instructions.
3.2.3 The luminaries and lamps shall be provided with such accessories as are required to complete the item in working condition whether specifically mentioned in the specifications, drawings or not.

3.3 **Luminaires:**

3.3.1 Luminaires shall comply with relevant IS and with clauses 3.3.2 to 3.3.7 both inclusive.

3.3.2 Unless otherwise indicated, enclosure of luminaires shall provide a minimum degree of protection of IP20 when located within buildings and IP44 when located outside buildings, but luminaires mounted externally; and less than 2 M above finished ground or paved level shall be IP46.

3.3.3 Unless otherwise indicated, luminaires, both with and without built-in ballast or transformers shall be suitable for direct mounting on normally flammable surface.

3.3.4 Where specific requirements related to flame propagation and flammability of translucent covers are indicated, certificates of tests shall be submitted to the Engineer-in-Charge. The tests shall comply with relevant IS.

3.3.5 Terminal blocks for connection of the supply cables shall be of adequate size for the size of conductors forming the loop in wiring unless separate tails are required. Wherever indicated, the terminal block shall incorporate a fuse of suitable type and rating.

3.3.6 Ballasts for tubular fluorescent lamps shall have a maximum value of harmonics complying with the colour headed “without H Marking” in Table VII of BS 288. Power factor correction shall be provided and this shall not be less than 0.85 lagging unless otherwise indicated.

3.3.7 Translucent covers and reflective surfaces shall be clean at the completion of the works.

3.4 **Lamps:**

3.4.1 Lamps shall be of the type and ratings as indicated.

3.4.2 All lamps shall be supplied and installed by the contractor unless otherwise directed.

3.4.3 Lamp caps shall be suitable for the lamp holders listed socket by means of a locking ring.

3.5 **Support and Fixings:**

3.5.1 Where fluorescent luminaries 1200 mm or more in length are supported directly by the conduit system, they shall be fixed to two circular conduit boxes both of which shall form an integral part of the conduit system.

3.5.2 Where the weight of a luminaire is supported by a conduit box or cable trunking, the fixing of the conduit box or trunking shall be adequate for the purpose and approved by Engineer-in-Charge.

3.5.3 Luminaries fitted with tungsten filament lamps and having metal back plates shall not be fixed directly to conduit box in which thermoplastic material is the principal load bearing member.

3.5.4 Support of luminaires from cable trunking shall be by means of proprietary clamps or brackets.

3.5.5 Where luminaries are supported from the structure other than by the conduit system, the supports shall be adequate for the purpose and approved by Engineer-in-Charge.
3.5.6 Luminaires mounted on or recessed into suspended ceilings shall not support luminaires unless specifically shown and approved.

3.5.7 For wall mounted luminaires, the mounting height shall be 1900 mm above finished floor level or as mentioned in the drawing, measured to the center of the conduit box, unless otherwise indicated.

3.6 **Wiring Connections:**

3.6.1 Where luminaires, other than those covered by clause 3.6.2 are fixed direct to circular conduit boxes or are supported by pedants or chains, the final circuit wiring shall terminate at a terminal block in the conduit box.

3.6.2 Where luminaries having fluorescent tubes are fixed direct to circular conduit boxes, the final circuit wiring may be terminated within the luminaire unless otherwise indicated. The wiring shall enter each luminaries at the conduit entry nearest to the terminal block and where a loop in wiring system is used, leave by the same entry; wiring shall not pass through a luminaire unless the approval of the Engineer-in-Charge.

3.6.3 Where luminaries are mounted on or recessed into a suspended ceiling, connection shall be by flexible cord from a plug-in ceiling rose unless otherwise indicated. The plug-in ceiling rose shall be located not more than 500 mm from the access in the ceiling and shall be firmly supported, unless otherwise approved by the Engineer-in-Charge.

3.6.4 Cables and flexible cords for final connections to luminaries shall be suitable for the operating temperature of the luminaire.

3.6.5 The size of final connection cables or flexible cords shall be as indicated.

3.6.6 Cables and cords passing close to a ballast within a luminaire shall be suitable for the operating temperature of the ballast.

3.6.7 A protective conductor shall connect the earthing terminal or earthing contact of each luminaire to an earthing terminal incorporated in the adjacent conduit box. Where the final connection is by flexible cord, the protective conductor shall form part of the cord.
4.0 **TELEPHONE SYSTEM WIRING & CONDUITING**

4.1.0 **Intent of Specification**

4.1.1 These specifications are intended to cover the Conducting & Cabling and under floor raceway work for Telephone & Intercom System. It is not the intent to specify completely herein all aspects of design, constructional features of equipment and details of the work to be carried out, but nevertheless the intent of the specification is to ensure that the equipment and work shall conform in all respects to the relevant Bureau of Indian Standard Specifications, Codes of Practice, and other statutory regulations as may be applicable and to high standards of engineering, design and workmanship. The equipment and work shall perform in continuous operation in a manner acceptable to the Employer who will interpret the meaning of the specifications and drawings and shall have the right to reject or accept any equipment or work which in their assessment is not complete to meet the requirements of these specifications and / or applicable Codes and Standards.

4.2.0 **Scope of Work**

4.2.1 The scope of work under these specifications shall include the design, manufacture, work’s testing, supply, storage, erection, site testing and commissioning of the following:

a) All conduit work including Junction Boxes, outlet boxes and wiring & cabling of telephone & intercom system etc.

b) Boxes & cover plates for telephone outlets.

c) Supplying and laying/fixing of main Telephone cables and Tag Blocks as per line diagram.

d) Connecting of Electronics earthing for EPABX system.

e) To do the ferruling and identification of all multi core cables at both the ends of each cable.

f) To do the testing of existing telephone cables & tag blocks (if already existing) before the start of work and intimate the condition of the same to the employer.

The scope of work shall also include all civil works associated with erection of the equipment and making good and painting the civil works as required.

The Contractor shall include for the supply of entire materials in accordance with these specifications and the whole of the work of fixing necessary material for the complete installation as set down in these specifications and with the accompanying schedules of work and drawings. Materials and components not specifically stated in the specifications and / or bill of materials or noted on the drawings but which are necessary for satisfactory installation and operation of the system shall be deemed to have been included in the scope of work.

4.3.0 **Specifications and Schedules**

4.3.1 The Specifications and Schedule of quantities shall be considered as part of this contract and any work or materials shown in schedule and not called for in the specifications or vice versa, shall be executed as if specially called for in both.

The drawings indicate the extent and general arrangement of telephone point outlets, Tag Block etc. and are essentially diagrammatic.
4.3.2 The work shall be installed as indicated on the drawings. However, any minor changes found essential to coordinate the installation of this work with other trades shall be made without any additional cost of the employer. The data given herein and on the drawings is as exact as could be secured, but its complete accuracy is not guaranteed. The drawings are for the guidance of the Contractor. Exact locations, distances and levels will be governed by the site conditions.

4.4.0 Departure from Specifications
4.4.1 Should the tendered wish to depart from the provisions in these specifications, such departure shall be listed in a separate schedule with full particulars and reasons for the same. No conditions or departures from specifications etc. will be accepted after decisions are communicated by the Engineer-in-charge.

4.5.0 Materials and Equipment
All materials and equipment shall be of the approved make and design. Only the best quality materials and equipment shall be used. The materials and equipment shall conform to relevant Standards.

4.5.1 Approved Makes of Material
Approved makes of material are indicated in the annexure to the Specifications / BOQ. Only such material shall be used. Alternative makes shall be used only with the specific written approval of the Engineer-in-charge.

4.5.2 Samples
A list of items of materials and equipment, together with a sample of each shall be submitted to the Engineer-in-charge within 15 days of the award of the Contract.

Samples and drawings of equipment shall not be departed from without the written instructions of the Engineer-in-charge. Approvals given by the Engineer-in-charge to any samples or drawings submitted by the Contractor shall not in any way exonerate the Contractor from his liability to carry out the work in accordance with the terms of the contract.

4.5.3 Substitute Materials
Any item which is proposed as a substitution shall be accompanied by all technical data given sizes, particulars of materials and the manufacturer's name. At the time of the submission of proposed substitution the Contractor shall state the credit, if any, due to the Client. In the event the substitution is approved, changes and substitutions shall be requested in writing and approvals obtained in writing from the Engineer-in-charge.

4.5.4 Manufacturers Instructions
Where manufacturers have furnished specific instructions, relating to the materials used in this covering points not specially mentioned in these documents, manufacturers instructions shall be brought to the notice of the Engineer-in-charge for further instructions in the matter.

4.5.5 Interchangeability
All similar parts and / or equipments shall be interchangeable with one and other.

4.5.6 **Material Testing**

The Employer shall have full powers to require the materials of work to be tested by an independent agency at the Contractor’s expense in order to prove their soundness and adequacy.

4.6 **Drawings**

4.6.1 Prior to the laying and fixing of the conduits, the Contractor shall submit to the Engineer-in-charge detailed shop drawings of the conduit network and get the same approved. The shop drawing shall indicate number, size and route of the conduits, location of junction/inspection/pull boxes, location and size of outlet boxes and number and size of wires carried in each conduit.

4.6.2 The Contractor shall prepare and submit for the approval of Engineer-in-charge detailed shop drawings of all Junction Boxes, special pull boxes and any other requirement to be fabricated by the Contractor within 10 days of signing of the contract.

4.6.3 General Arrangement drawing giving details of cable, size and type of cables, number of cables, mode of installation etc.

4.7 **Cleaning, Final Painting And Marking**

4.7.1 All exposed steel work not actually embedded will be painted as instructed. All tag blocks shall be properly labeled and numbered. The scope of work shall include the same without any extra charge. The Contractor shall be required to clean all equipment under erection as well as the work area and site at regular intervals to the satisfaction of the Engineer-in-charge. In case the cleaning is not to the satisfaction of Engineer-in-charge the same will have to be done again at the Contractor’s Cost.

4.8 **Completion Certificate**

4.8.1 On completion of the telephone & computer wiring & cabling, a certificate shall be furnished by the Contractor countersigned by the Licensed Supervisor, under whose direct supervision, the installation was carried out. The contractor shall get the certification of the Competent authority for the complete system after commissioning.

4.9 **Works Inspection**

4.9.1 Prior to shipment of equipment, the Engineer-in-charge reserves the right to inspect the same at the manufacturers works and the Contractor shall provide and secure for the Engineer-in-charge and his authorized representative every reasonable access and facility at the manufacturers works for inspection.

4.10 **Co-Ordination Of Work At Site**

4.10.1 The Contractor shall work in co-ordination with other agencies at site and shall arrange to place the conduits/inserts etc. in the masonry and concrete as required, as other works proceed. Any hold up of the building or other works because of delay in placing the conduits /
inserts etc. or otherwise shall be the responsibility of the Contractor and shall make him liable for damages as may be considered and levied by the Engineer-in-charge.

4.11 **Partial Occupation of Premises**

4.11.1 During progress of the work completed portions of the building/ floor may be occupied and put to use by the Client. The Contractor shall however remain fully responsible for the maintenance of the installations till the entire work covered by this Contract is satisfactorily completed by him and taken over by the Institute.

4.12 **Appointment Of Sub Contractor & Supplier For Telephone Work**

4.12.1 The main contractor shall get the name of the telephone wiring sub contractors approved from the Engineer-in-charge before the work is taken up in hand. The sub contractor shall be licensed electrical contractor and shall be registered Contractor of P&T/DOT.

4.12.2 The Supplier of EPABX should be an OEM authorized distributor/ dealer/ re-seller of the offered equipments. An authorization letter in this effect from the OEMs must be enclosed. The Supplier shall provide technical brouchers from OEM to support the technical specification of all the offered items. The Supplier shall offer 1-year comprehensive on-site warranty and shall also quote rate for 3-year comprehensive on-site warranty.

4.13 **Conduit**

Conducting shall be done as per the specification mentioned in Wiring Section.

5.0 **T.V. Master Antenna System**

5.1 The contractor shall supply, install and test T. V. master antenna system according to bill of quantities. The system shall consist of the following parts as specified herein. Proper operation of equipment and material shall be guaranteed by the contractor. The scheme of MATV system shall be prepared and got approved by the Architect.

The system shall be based on CCIR regulations and 625 lines, PAL system. They shall be suitable for colour as well as monochrome transmission and distribution. The colour will be based on PAL system.

The supplied and ambient conditions will be as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>220 V.</td>
</tr>
<tr>
<td>Supply Frequency</td>
<td>50 Hz.</td>
</tr>
<tr>
<td>Maximum Ambient Temp</td>
<td>-59C</td>
</tr>
<tr>
<td>Minimum Ambient Temp</td>
<td>-20C</td>
</tr>
<tr>
<td>Maximum relative humidity</td>
<td>-90%</td>
</tr>
<tr>
<td>Altitude above seal level</td>
<td>-250M</td>
</tr>
</tbody>
</table>

5.2 **Splitter / Tap Off / Outlets / Attenautors.**

The system shall comprise of the required number of splitters. Tap Off s and Wall outlets.
The system should be provided with Attenuators wherever necessary to bring the signal level within the permissible limits of 67-80 dB.

The tap off s will have a VSWR(less than 1.3) Outlet shall be of 75 ohms with F type connectors. The loss of the through type wall socket should be as follows:

<table>
<thead>
<tr>
<th>Loss</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion loss</td>
<td>0.8dB</td>
</tr>
<tr>
<td>Tap loss</td>
<td>less than 11 dB</td>
</tr>
</tbody>
</table>

Each outlet shall be provided with one 75/300 balanced matching transformer in neat moulded plastic case with push plug at the other and with 1.5 meters of 75 ohm coaxial cable. The system should comprise of F type connectors for better contract.

5.3 **Cable**

Whenever applicable LAN / DATA VOICE cable shall be CAT 6E & CAT 5 coaxial cables for high frequency application.

The complete system shall be drawn in steel conduits except for GI pipe for external routing. The cable shall be coaxial type. PVC sheathed, with attenuation as under:

- 70 dB/KM at 90 MHz.
- 130 dB/KM at 200 MHz.

5.4 **Testing**

All system shall be tested and adjusted for proper operation after the installation. Each outlet shall be tested for proper reception by the contractor in presence of the consulting engineer / architect representative.

Any defect shall be rectified at no extra cost to the Client.
6.0 FIRE ALARM SYSTEM

GENERAL

6.1 Work Included

a) The scope of work under this head shall include design (if required) supply and installation of Analogue Addressable Fire Detection Cum Alarm System. The work under this system shall consist of furnishing all materials, equipments and appliances and labour necessary to install the said system complete with Detectors, Hooters and Manual Push Button Stations and Fire Alarm Panel etc.

The Design consists of providing Analogue Addressable Detectors, Hooters, Manual Call Points, Response Indicators and Fire Alarm Panel as per specifications.

It shall include laying of wiring and conduits etc. necessary for installation of the system with supply of detectors as indicated in the specification and schedule of quantities. Any openings/chasing in the wall/ceiling required to be made for the installation shall be made good in appropriate manner.

b) Related Work and Obligations

i) The general requirements apply to work specified in this section.

ii) To examine all the other sections of the specification for requirements which may affect work of this section.

iii) Co-ordinate works with all other trades affecting, or affected by activities of this section. Co-operate with such other trades to assure the steady progress of all operations under the Contract.

c) General Requirements

This specification covers requirements for supply, erection, testing and commissioning of Analogue Addressable Fire Alarm System.

d) Codes and Standards

The design, supply, installation and testing of the entire fire alarm system shall confirm to BS: 5839 or NFPA 72. The detectors shall conform to relevant codes for Fire Alarm Systems.

e) Quality Assurance

The Contractor shall ensure that all materials furnished and installed by him under the Contract shall meet the requirements of relevant International and Indian Standards. The Contractor shall also verify all test results and ensure that these are in accordance with the requirements as mentioned in the specifications.

f) Guarantee

Manufacturer shall provide guarantee for work under this section. However, such guarantee shall be in addition to and not in lieu of all other liabilities which manufacturer and Contractor may have by other provisions of the Contract document.

The Fire Alarm System shall be guaranteed against trouble free operation, defective workmanship and materials for a period of 18 months from the date of supply or 12 months
from the date of erection and commissioning whichever is earlier. In case of any defects during this period detectors etc. shall be replaced free of cost by the Contractor.

g) Delivery, Handling and Storage

All Detectors, Hooters, MCPs, RIs and Fire Alarm Panel shall be carefully handled and stored at site in a neat and orderly manner for fixing the same at a later date.

6.2 Products

a) General Detail

The Fire Alarm System shall conform to BS : 5839 or EN 54 or NFPA 71/ 72 or Under writer’s Laboratory in respect of design and installation and it shall give Audio / Visual Alarm Signals when the temperature in case of Heat Detector or smoke density in case of Photo Electric Detector exceeds the pre-set limit. The system shall give pin point location of fire with warning system and voice communication for commands and instruction if required.

b) Photo Electric Type Smoke Detector Combined with Class ‘A1’ Thermal Sensor.

The Photo Electric Smoke Detector has an optical sensing chamber that operates on the light scattering principle and responds to those particles that exit from optically dense smoke. When Smoke enters the sensing chamber it scatters light which is received by a photo cell. The signal is amplified and digitised for reception by the Panel. The Detector shall activate on receiving smoke particles in the 0.5 to 10 micro meter range. The detector shall be completely solid state with LED indication at the base.

The Photo Electric Smoke Detector shall be combined with Class ‘A1’ thermal sensor. Each element shall have monitoring possible for measuring actual levels, as well as temperature rate of rise. When required it shall be possible to isolate smoke sensing while retaining thermal sensing.

The Detector shall be able to sense incipient fire by detecting the presence of visible and invisible products of combustion. The detector shall be suitable for low voltage (24 volts DC) two wire supply. The detector shall be provided with response indicator (LED) and the sensitivity of the detector shall not vary with change in ambient temperature, humidity, pressure of voltage variation.

Neither its performance shall be got affected by air circuit upto 10 Mtr. Per second. The detector shall be suitably protected against dust accumulation/ ingress and it shall be free from maintenance and functional test at intervals. All detectors shall be identical in construction design and characteristic to facilitate easy replacement. The detector housing shall be damage resistant made of polycarbonate or proprietary self extinguishing material.

The coverage per smoke detector shall be upto a minimum of 70 Sq.M. This coverage area will reduce depending upon structural configurations or partitions etc. It shall be possible to connect Smoke Detector with Heat Detector or Manual Push Button in the same circuit. The sensitivity of detector shall be set / adjusted by the supplier to suit the site requirement.

It shall have in-built safety device to monitor the removal and pilferage of the detector. The detector also must have facility for remote indication. The quiescent current flow must not exceed 50 milli amps and alarm condition current shall be maximum 60 milli amps.
The Photo Electric type Smoke Detector combined with Class ‘A1’ thermal sensor shall be intelligent Analogue Addressable detector with its own manually set digital code and be able to give analogue output to the Fire Alarm Panel regarding its condition. It shall be able to communicate with the Fire Alarm Panel by the pulses emitted from the Panel.

The base of the Detector shall be interchangeable with other Smoke or Heat Detectors. The enclosure shall meet IP 22 protection grade.

It shall be able to withstand temperature variation from 0 Degree Centigrade to 50 Degree Centigrade. Relative Humidity (non Condensing type) upto 95% shall not hamper its performance. The voltage rating shall be from 24 Volts DC, though the voltage may be changed depending upon the working voltages of a proprietary Fire Alarm Panel.

c) **Rate of Rise Type Heat Detector**

The Heat Detector shall be intelligent Analogue Addressable detector with its own manually set digital code and be able to give a single digitised output to the Fire Alarm Panel regarding its condition. The Detector shall employ the thermistor principle for heat sensing and the fixed temperature setting shall be at 60° Centigrade. It shall be able to communicate with the Fire Alarm Panel by the Electrical pulses emitted from the Panel.

The Base of the Detector shall be interchangeable with other Smoke Detectors and the Construction shall be of poly carbonate or any approved proprietary flame retardant material. LEDs shall be provided to indicate locally alarm condition. The enclosure shall meet IP 22 protection grade.

It shall be able to withstand temperature variations from 0° Centigrade to 50° Centigrade. Further, Relative Humidity (non Condensing type) upto 95% shall not hamper its performance. The Voltage rating shall be 24 Volts DC, though the voltage may be changed depending upon the working voltages of a proprietary Fire Alarm Panel.

The detector shall meet the requirements of either EN 54/ FM/ UL and shall be specifically approved by FM/ UL/ LPCB. It shall be possible to test the Detector’s working both from the Panel as well as locally by means as designed by the Bidder. The approved coverage per Detector for unhampered areas shall not be less than 30 M²

d) **Manual Call Box.**

Manual Push Button shall be of Break Glass or Pull Down type units, completely encased in cast aluminium housing or in 16 gauge MS with provision for cable or conduit coupling. The manual Push Button shall have the word prescribed in clear bold letters on facial window “In case of Fire Break Glass/ Pull Down”.

The Manual Call Box station shall be fully addressable with its own set code and operated by digitized signals sent from the Panel. The voltage range shall be from 24 Volts. It shall have protection as per IP 33. The Operating temperature range shall be from 0 Degree Centigrade to 50° Centigrade. Relative Humidity (non condensing) range for performance parameters shall be between 0 to 95%. Further it shall confirm to BS 5839 or EN 54/ FM/ UL/ Vds/ LPC.

In case the manual call box is indigenous and an Input Card is connected to it then the Manual Call Box with Micro Switch shall be approved by the Consultant.

e) **Hooter**
The Hooter shall be of electronic type and shall give discontinuous / intermittent audible alarm whenever any detector or call box operates. It shall be possible to control the hooter audible alarm in case it is not required to sound the alarm except for the panel.

It shall be complete with electronic oscillations, magnetic coil (sound coil) and accessories, ready for mounting (fixing).

The sound output from the Hooter should not be less than 100 decibels at the source point. Hooter shall be 4 W each and enclosed in an acoustically lined MS box.

f) **Fault Isolator**

The Fault Isolator shall be able to detect wire short circuit/ loose wiring/ partial earth fault and similar conditions and shall be able to isolate that segment from the circuit, so that the rest of the circuit continues to operate.

Fault Isolator shall operate in pairs in any loop and whenever any short circuit occurs between any two of them, both immediately shall switch to an open circuit state and isolate the length of wiring between them. The Isolators should automatically return to the closed circuit as soon as the short circuit is corrected.

The Fault Isolator shall be addressable so as to provide indicate of its changed state. It shall also have an inbuilt LED to give local alarm.

g) **Fire Alarm Control Panel**

1) The fire Alarm Control Panel shall be micro processor based fully Addressable Analogue Control Unit which shall control all addressable detectors, Manual Call Stations, Interface Units and Switching Systems (for disconnecting AHU and power supply) connected to it.

2) All addressable units shall be connected to the Panel through the Loop Cards and shall be addressed through individualized numbers. The Panel shall be able to obtain analogue value for all detectors in the Circuit through a pulsed digitalized current data. The Panel shall be able to analyze all analogue inputs from all addressable units and through its own software and ambient level screening it shall be able to identify Fire, possible Fire or Fault conditions. The unit shall be dynamic and continuous.

3) The Fire Alarm Panel shall itself have all Zone Cards in it. No isolated mother board or transponder is being considered. Each Loop shall be able to access a minimum of 90 addressable units. The Design has been based on the basis of 90 units per Loop.

4) The Panel shall also give adequate warning signal whenever there is dust accumulation in detectors, and up to the point of its replacement it should be possible to change the level of ambient alarm calibration condition either by the use of software programme operable by the Client or by resetting the detector.

5) Short circuiting, loose wiring or missing units shall also be reported at the Panel with pin point location. In such cases the system through the use of Fault Isolators shall be able to isolate that segment between the two fault isolators.

6) The Panel shall have a Liquid Crystal Display Alpha – Numeric type on it to indicate immediately all conditions. In case of testing of the system from the Panel, the Display shall be able to give readouts of analogue value of all detectors being tested. The Panel shall also be able to carry out
continuous self monitoring when in normal condition. The Mother Board shall be of Modular Construction.

7) The Panel shall have either an in-built or external printer coupled to the Panel which shall log all events with time. The printout shall clearly indicate the event – Fire / Pre Alarm / Fault etc. the Unit address and time.

8) The Panel shall also be able to discriminate between false alarms and fire conditions, as well as priority selection of alarm address in case alarm activities in tow or more remotely located units simultaneously. In such cases, the Manual Call Box shall be reported first, group of sequentially laid detectors (in one room for example) second and a detector with the greatest obscuration over a period of time third.

9) The Panel shall also be able to actuate Switches automatically in case of Fire condition, that of AHUs and Power Supply or other Systems such as piped pressurized gas supply. The Bidder will be required to design and install the system in operation in coordination with the relevant Contractors. The Bidder will not be allowed to charge extra on this account, and such charges shall be included in his package.

10) In this respect the Bidder is required to take note of the specifications mentioned above. The Bidder shall indicate in his Bid what facilities shall need to be provided by the Client for completion of this mechanism.

11) The System should be fully safe and adequate safe guards should be under taken that in the event of a failure of a part of the System it shall not handicap the complete system.

12) The Bidder shall undertake the responsibility of the complete installation, commissioning, user trials, training and maintenance of the system as required. The Bidder shall take all responsibility for preparation and installation of system Software into the Panel. The Software shall be such so as to be easily operated by the Client’s Personnel, is secured against Software errors, ability to be upgradable so as to incorporate more Detector units or replacement / changing of Detector units, can incorporate more features at a later date such as Illumination Control, Security etc.

13) The Panel shall be able to address individual Interface Cards which shall be connected to conventional detectors.

14) The Panel shall have its own Battery Back up of a minimum of 12 hours run. The Battery shall be of Nickel Cadmium or as per Manufacturers Standard of capacity as required and accepted by the Client.

15) The Panel shall also have its own Annunciatory System either inbuilt or by external source. The Microphone shall have a selector switch to tune onto the required speaker / speakers and give the necessary voice announcement.

16) It shall be able to withstand temperature variations from 0 Degree Centigrade to 50° Centigrade. Further, Relative Humidity (Non Condensing type) upto 95% shall not hamper its performance. The Voltage rating shall be 24 V DC, though the voltage may be changed depending upon the working voltages of a proprietary Fire Alarm Panel.

17) The Panel shall be totally enclosed dust and vermin proof type made of minimum 16 gauge dust inhibited sheet with even baked finish. The panel shall be of completely solid state design.
18) The logic circuits shall be based on high noise immunity solid tasted hardware employing modular construction. Logic cards shall be of epoxy fibre glass construction.

19) The System shall meet the BS 5839/ EN 54/ NFPA 71 & 72 standards and all equipments excluding cabling and wiring shall be listed with Under writers Laboratory or Factory Mutual.

20) Further, the system shall be expandable and be able to add at least 200 more units in the Panel through additional Loops.

21) The Panel shall have an extra Zone/ Loop Card to serve as Standby in case of burn out of or malfunctioning of any operating Zone/ Loop Card. If the Bidder envisages two numbers of 2 Loop cards to serve the 4 Loops of the proposed System, then the extra Loop Card shall also be a 2 Loop Card.

22) The Panel shall have software to cater to the change over of any of the operating Loop Cards to the extra Loop Card. Other Software necessary to actually change the terminals of a Loop from an existing Loop Card to the extra Loop card shall be carried out at site as and when required. Charges for such software, loading, test run etc. shall be indicated when required.

6.3 Exit Sign

1) Exit Sign : Photo Luminescent Type

2) Size : As per site requirements

3) Indications : As per site requirement

6.3.1 Cable / Wire & Conduit

This shall be as per the detailed specifications in Wiring Sub head.

6.4 Installation

6.4.1 Manual Stations

Manual Stations shall be mounted with the base of 1.50 m above the Finished floor level unless otherwise noted.

6.4.2 Evacuation Alarm Bells

Evacuation Alarm Bells shall be mounted at least 2.10 m above the floor level unless limited by ceiling height or otherwise noted.

6.4.3 Detectors

Detectors shall be mounted at the underside of ceilings or roof decks.

6.4.4 Main Fire Alarm Panel

It shall be installed in the Main Security Room.

6.5 Examination of Work

Upon completion of the installation, the Contractor shall test the entire Fire Alarm System to the satisfaction of the Engineer-in-charge. The Contractor and Fire Alarm Technician shall be in attendance to make necessary adjustments and perform electrical work related to the test. The
installation shall be got approved from the competent Government authorities after testing & commissioning if required.

7.0 **EARTHING**

7.1 **Scope:**

7.1.1 The scope of this section covers supply installation and testing of earthing system for all non-current carrying metal parts of electrical installation.

7.1.2 The type and number of earth electrodes shall be as indicated and shall comply with clauses as appropriate.

7.1.3 Dedicated earthing shall be provided for the Server Room equipments.

7.2 **Earthing System & Equipment Bonding:**

7.2.1 Unless otherwise indicated, earth plates shall be 600 mm x 600 mm minimum, of solid or lattice copper not less than 3.15 mm thick and of GI not less than 6.3 mm.

7.2.2 Earthing system shall comprise of earth electrode near sub-station. Test link boxes shall be provided at each electrode for periodical resistance measurement. All such earth electrodes shall be interconnected forming a main grid.

7.2.3 Where the earth electrodes are formed with tape, the tape shall be to relevant IS, of the size, length, depth below ground level and layout as indicated.

7.3 **Conductors:**

7.3.1 Earthing conductors, main earthing bars and main equi-potential bonding conductors shall be of the type, size and conductor material as indicated and shall comply with clauses 15.3.2 to 15.3.5.

7.3.2 Tapes shall comply with relevant IS. Where used to interconnect copper electrodes the tape may be bare, but for interconnecting pipe electrodes and for all other purposes the tap shall have an extruded PVC sheath.

7.3.3 Main earthing bars shall comply with IS 3043 and shall be bare.

7.3.4 Cables shall comply with IS 3043, without sheath, unless otherwise indicated.

7.4 **Joints and Connections:**

7.4.1 Joints in conductors shall be kept to a minimum.

7.4.2 All contact surfaces shall be thoroughly cleaned and coated with an anti-corrosive electrical jointing compound suitable for the conductor materials. For bi-metallic joints, a separate abrasive shall be used to clean each metal.

7.4.3 Connections shall be made as follows:

- to main earthing bars by phosphor bronze set screws and nuts;
- to earth rods by bronze, gunmetal or copper clamps with phosphor bronze. Edges of clamps shall be rounded;
- to earth pipes by phosphor bronze bolts and nuts, direct to the flange of the pipe;
- to earth plates by bolting, riveting or welding.
7.4.4 Termination of cables shall be by connectors jointed to the cable conductor by the thermit welding process or by compression joints complying with BS 4579.

7.4.5 Joints which are indicated as test points shall be bolted or clamped. Joints in tape, other than at test points shall be made by the riveting and sweating. Overlap of conductors shall be not less than 100 mm.

7.4.6 Joints and connections shall be protected by a coating which will form a seal and exclude moisture in all weather conditions. At connections to earth electrodes, the coating shall cover all exposed conductors and in the case of earth pipes, to top surface of the flanges. Protective coatings shall be of a waterproof, inert, tenacious material and of one of the following forms:

1. solvent cutback thyrotrrophic corrosion preventative forming a film of resilient matt petroleum wax;
2. a fast drying durable rubberized sprayed coating;
3. a heat shrink clear sheathing.

7.4.7 Screws, nuts, washers and rivets for copper conductors shall be of phosphor bronze, naval brass or copper silicon; for aluminum conductors, they shall be of stainless steel. The minimum provision shall be

1. For flat strip—two M8 bolts or four 5 mm diameter rivets;
2. For sheet metal—two M8 bolts; where the sheet metal is less than 2 mm thick, it shall be backed for an area of at least 1000 mm2.

7.5 **Inspection Pits:**

7.5.1 Unless otherwise indicated, connection between an earth conductor and its associated earth electrode system shall be in an enclosure.

7.5.2 The enclosure shall have a removable top cover which shall be flush with finished ground level. The enclosure shall be a purpose made concrete inspection pit, a galvanized steel inspection pit embedded in concrete, an earthenware pipe or similar, as indicated. The earth electrode connection shall be just below the lid of the inspection pit with adequate access for testing purposes.

7.6 **Supports and Fixings:**

7.6.1 Cables shall be supported and fixed in accordance with Section Cable laying.

7.6.2 Tapes and bars shall be fixed by spacer bar saddles which shall be of non-metallic material or corrosion resistant alloy compatible with the conductors. Fixing of saddles shall comply with relevant clauses in Cable Laying section. The maximum spacing off fixings shall not exceed 600 mm unless otherwise indicated.

7.6.3 Main earthing bars shall be supported on insulators; they shall be not less then 25 mm clear of the building fabric.
7.6.4 For general areas inside buildings, screws and nuts shall be of cadmium electroplated steel or stainless steel; outside buildings, in plant rooms or other locations as indicated, they shall be of stainless steel.

7.6.5 No shot firing shall be used and no drilling or welding structural steelwork shall be done without the approval of the Engineer-in-Charge.

7.7 Installation:

7.7.1 Electrodes shall be installed in undisturbed ground. The distance between any two electrodes shall be not less than 1.25 times the depth of the longer electrode.

7.7.2 Excavations shall be carried out in accordance with BS 6031 and shall comply with the construction (General Provisions) Regulations, 1961. Excavations shall be kept free of water and protected against damage or collapse. The safety of persons and the protection of structures, buildings, roads, sewers and services from damage shall be ensured; all necessary sheeting, timbering, strutting and shoring shall be supplied, erected and subsequently removed.

7.7.3 Trenches shall be backfilled in layers and each layer shall be rammed. The first two layers shall be 100 mm deep and rammed by hand the remaining layers shall be not more than 200 mm deep and power ramming may be used. Warning tapes and covers shall be included as specified in relevant clauses in Cable laying section. Where applicable, top soil and turf shall be replaced and the final level shall be level with or not more than 25 mm above the adjacent ground level.

7.7.4 The earth resistance should be less than 5 Ohms. Earth Pits shall be treated with salt, charcoal/chemicals to achieve the required result.
EARTHING (MAINTENANCE FREE)

G.I Pipe - 48 mm x 3000 mm

1) Type of Earthing: Sealed maintenance free chemical filled earthing electrode.
2) Diameter of the pipe: 48 mm
3) Thickness of the pipe: 1.5 mm (16 S.W.G)
4) Length of the pipe: 3000 mm
5) Galvanized thickness: 76 - 100 micron
6) Type of galvanizing: Hot dipped
7) Size of the conductor: 32 x 6 G.I Strip
8) Terminal diameter: 12 mm
9) Chemical used in the pipe: CCM Approximate weight - 4 Kg
10) GBFC (Ground Back fill Compound):
   I) Minimum 45 Kg it is soil enrichment chemical mainly consisting of Aluminum Silicate.
   II) It Absorbs moisture but doesn’t get dissolved in water.
   III) It can absorb water 13 times of its weight.
   IV) The top & bottom of the pipe is sealed permanently.

Cu Pipe - 48 mm x 3000 mm

1) Type of Earthing: Sealed maintenance free chemical filled earthing electrode.
2) Diameter of the pipe: 48 mm
3) Thickness of the pipe: 1.5 mm (16 S.W.G)
4) Length of the pipe: 3000 mm
5) Galvanized thickness: 80 - 100 micron
6) Type of galvanizing: Hot dipped
7) Size of the conductor: 32 x 6 G.I Strip
8) Terminal diameter: 12 mm
9) Chemical used in the pipe: CCM Approximate weight - 4 Kg
10) GBFC (Ground Back fill Compound):
   I) Minimum 60 Kg it is soil enrichment chemical mainly consisting of Aluminum Silicate.
   II) It Absorbs moisture but doesn’t get dissolved in water.
   III) It can absorb water 13 times of its weight.
   IV) The top & bottom of the pipe is sealed permanently.
8.0 INSPECTION AND TESTING:

8.1 General:

8.1.1 Inspection and testing shall be done in accordance with the IEE Wiring Regulations, the requirements of this Section and as indicated.

8.1.2 Inspection shall include a physical check that all equipment has been securely fixed and that all electrical connections are mechanically sound.

8.1.3 In addition to the test at the completion of each installation, certain tests shall be done during the progress of the Works as required by clauses 17.4 to 17.7 both inclusive.

8.2 Information:

8.2.1 For equipment supplied under the contract, the Contractor shall obtain from manufacturers the time/current characteristics of all protective devices for automatic disconnection of supply and provide copies to the Engineer-in-Charge and to the person or persons carrying out the inspection and testing, in addition to meeting the requirements of clause.

8.3 Testing Methods:

8.3.1 The Engineer-in-Charge shall be notified of the method to be used for each type of test and the notification shall be given not less than 28 days before the final tests are to be made. The tests shall be carried out in accordance with the methods set out in the IEE Wiring Regulations, subject to the requirements of clauses 17.3.2 to 17.3.6 inclusive.

8.3.2 For testing, continuity of protective conductors and equi-potential bonding AC source shall be used unless the Engineer-in-Charge agrees otherwise.

8.3.3 The method used to verify the effectiveness of the protection afforded by a residual current-operated device shall give the operating time and the current used shall not exceed 100% of the nominal setting of the device. For a fault voltage operated device, the test voltage between the exposed conductive part and earth shall not exceed 50 volts. In addition to the tests simulating an appropriate fault condition, any test facility incorporated in the device shall be operated to test its effectiveness.

8.3.4 High Voltage tests on LV cables and factor assemblies shall comply with the requirements for site testing in the appropriate British Standards.

8.3.5 Alternative methods to those set out in the IEE Wiring Regulations may be proposed for the approval of the Engineer-in-Charge, but they shall be not less effective than those in the Regulations.

8.3.6 Where necessary to prevent damage to components of equipment, the equipment shall be disconnected for the duration of the relevant tests.

8.4 Power Cables:

8.4.1 Tests shall be made immediately on completion of the installation of power cables to demonstrate that the phase sequence is correct at all end connections.

8.4.2 Where indicated, LV cables shall be tested at high voltage in accordance with clause 17.3.4 as soon as their installation is complete.
8.4.3 LV cables not required to be high voltage tested, shall be tested for insulation resistance as soon as their installation is complete. The test voltage shall be 500V DC for installations rated up to 500V and 1000V DC for installations rated up to 1000V. Tests shall cover all permutations between each conductor, screen, metallic sheath, armour and earth.

8.4.4 The over sheaths of cables laid under ground shall be given a voltage withstand test after backfilling of the trenches is complete but before termination.

8.5 **Control and Communication Cables:**

8.5.1 Cables shall be tested as soon as their installation is complete to ensure that the cores are continuous and they have not been crossed and the insulation resistance is satisfactory. Insulation tests shall cover all permutations between each conductor, screen, metallic sheath, armour and earth.

8.5.2 For polyethylene and dry paper-insulated communications cables, the insulation resistance for each conductor shall be not less than 1500 L mega ohms, where L is the cable length in Kilometres. The measured resistance of each conductor shall not exceed the calculated resistance by more than 5%; the calculated value will be made available by the Engineer-in-Charge.

8.6 **Conduit and Trunking:**

8.6.1 Where conduit is cast in situ in reinforced concrete, it shall be checked for freedom from blockage and steel conduit shall be tested for electrical continuity as soon as the shuttering has been removed.

8.6.2 Steel conduit and bus duct systems shall be inspected and tested before any wiring is installed; under floor ducting shall be inspected and tested before screeding.

8.7 **Earth Electrodes:**

8.7.1 The resistance of each earth electrode, whether for earthing of protective conductors, lightning protection or an electrical system, shall be checked immediately after installation of the electrodes and the results submitted to the Engineer-in-Charge.

8.8 **Earth Fault loop impedances:**

8.8.1 The measured earth fault loop impedance for each circuit shall be checked against the maximum value as indicated.

8.8.2 Where the maximum value is exceeded the Engineer-in-Charge shall be informed.

8.9 **Records and Certificates:**

8.9.1 Inspection and test results shall be recorded on the forms provided by the Authority. Two copies shall be submitted to the Engineer-in-Charge within 7 days of each test.

8.9.2 When all inspections and tests results are satisfactory, a Completion Certificate and an Inspection certificate shall be given to the Engineer-in-Charge not later than the date of completion of the works. The certificates shall be given in the form laid down in the IEE Wiring Regulations for electrical installations and BS 5266 for emergency lighting systems.

8.9.3 The values of prospective short-circuit current and earth fault loop impedance at the origin of the installation shall be recorded on the Inspection certificates.
9.0 **DRAWINGS AND DOCUMENTS BY CONTRACTOR:**

9.1 **Extent of Provision:**

9.1.1 Unless otherwise indicated, the Contractor shall provide the shop drawings and documents specified in following clauses.

9.1.2 The numbers of sets of drawings and documents to be supplied shall be as indicated.

9.2 **Shop Drawings and Documents:**

9.2.1 Shop drawings and documents including diagrams and schedules shall show the details of the Contractor's proposals for the execution of the works and shall include everything necessary for the following purposes:

a. To illustrate in details, the arrangement of the various sections of the works and to identify the various components;

b. To integrate the works with the detail of the building and other installations.

9.2.2 Shop drawings shall include:

a. General layout drawings showing the location of all equipment including cable; cable tray, conduit ducting and earth electrodes;

b. Detailed layout drawings showing the location of all equipment including cable, cable tray, conduit and ducting in switch rooms and plant rooms;

c. Assembly drawings of factory Built equipment and site built assemblies;

d. Detailed layout drawings showing the connection of cable and conduit to equipment;

e. Detailed layout drawings showing the connections through ceiling voids and vertical shafts;

f. System diagrams, circuit diagrams and wiring diagrams for all installations and equipment.

9.2.3 Diagrams shall comply with relevant IS. Interconnection diagrams shall indicate the type of cable, conductor size and terminal numbering.

9.4 **As Built Drawings:**

9.4.1 As-built drawings, including diagrams and schedules shall show all the information necessary so that each installation can be operated, maintained, inspected and tested so as to prevent danger, as far as is reasonably practicable. They shall incorporate the information necessary for the identification of the devices performing the functions of protection, isolation and switching, and their locations. The value of prospective short-circuit current and earth fault loop impedance at the origin of the installation shall be recorded on the appropriate system diagram.

9.4.2 Circuit details including loading, route, and destination and where buried, the depth below finished ground level shall be shown for each cable, conduit, and ducting. Conductor size and material and the type of insulation of all cables shall be shown together with the number of cores in each cable, the number of cables in each conduit, trunking or ducting.
Where identification is by colour of insulation or sheath, this shall be shown. Joints and draw boxes shall be shown.

9.4.3 Where incoming supply cables are installed by others, they shall also be shown as described in clause 17.4.2.

9.4.4 Drawings shall indicate whether conduit or ducting is surface mounted, concealed in ceiling, spaces in wall chases, in floor screeds or cast in mtu.

9.4.5 All earthing conductors, main equi-potential bounding conductors, main earthing terminal or protective conductors and supplementary equi-potential bonding conductor shall be identified with function, origin route, destination, conductor size and material, type of insulation and where buried, the depth below finished ground level test points shall be indicated.

9.4.6 Earth electrodes shall be identified to their types, dimensions, material and depth below finished ground level. The nature of the soil and any treatment that has been given to it or special fill that has been used in the installation shall be identified.

9.4.7 Details of each item of equipment including luminaires shall include electrical characteristics, classification, degree of protection against ingress of solids and liquids, class of protection against corrosion and manufacturer's name and reference.

9.4.8 Diagrams shall comply with 17.2.3 and they shall be supplemented with physical arrangement drawings to assist the location and identification of component parts of equipment.

9.4.9 During the course of the works, the contractor shall maintain a fully detailed record of all changes to ensure that the as-installed drawings are in all respects accurate.

9.4.10 Each drawing shall be in accordance with relevant IS to ensure suitability for micro-filming and shall be on durable translucent material, other than paper, of a standard size AO to A4 in accordance with relevant IS. The words 'AS-BUILT' shall be place in 19 mm block letters adjacent to the title block of each drawing together with the name of the site and the section of the works, the title of the installation, the date of completion of the works, the Authority's contract number and the name of the Contractor.

9.4.11 A draft of each as built drawing shall be submitted to the Engineer-in-Charge before final issue is made.

9.5 Maintenance and Operating Instructions:

9.5.1 For each electrical installation, system and individual equipment forming part of the works, the maintenance and operating instructions shall include:

a) A description of the extent and manner of operation, including duration periods of standby systems;

b) A description of the method used for compliance with Regulation 413-3 of the IEE wiring Regulations together with time/current characteristics for all protective devices or automatic disconnection of supply.

c) Copy of the inspection certificate and all the test records.
d) A copy of any certificates of compliance with relevant standards or schemes as may be required.

e) Comprehensive instructions for the switching on, operation, switching off and isolation, and for dealing with emergency conditions.

f) Instructions for any precautionary measures necessary.

g) Instructions for servicing, including frequency and materials to be used, to maintain the equipment in good and safe condition.

h) The names and addresses of suppliers of all major components together with the type and model reference, serial number, duty rating and the order number and date.

9.5.2 Maintenance and operating instructions shall be indexed and contained in ring binders with stiff covers. The name of the site and the Authority's contract number shall be printed on the front and spine with, where more than one volume is necessary, a suitable identification title. The date of completion of the works shall be included on a flyleaf.

9.5.3 Copies of manufacturer's data may be incorporated to supplement the descriptions and instructions required in clause 17.5.1 but shall not replace them. Only data relevant to the works shall be included. Where non relevant data appears on the same sheet, it shall be cleared marked to show that it is not applicable. The data shall be cross referenced within the text and included in the index; if possible, it shall be contained in the ring binders, but where this is not possible, suitably protected box files or folder shall be provided, identified in accordance with clause 17.5.1.

9.5.4 A draft of the maintenance and operating instruction shall be submitted to the Engineer-in-Charge before the final documents are issued.

10.0 SAFETY REQUIREMENTS:

10.1 Scope:

10.1.1 Safety procedures as laid down in Indian Standards shall be strictly followed during erection and commissioning.

10.1.2 The safety provisions required under the IEE Rules shall be provided for which no extra payment shall be made.
## LIST OF APPROVED MAKES

1. PVC Conduit & Accessories : AKG / BEC / POLYCB
2. L.T. Panels/MV Panel/Switch boards : Siemens/Schneider/SPC Electrotech
3. Capacitor Panels : Siemens/Schneider/SPC Electrotech
4. Sob Panel : Siemens/Schneider
5. HT Panels (11kv/33kv) : 1st/Areva/Schneider/Siemens/L&T (System Integration- SPC Electrotech)
6. VCB Panels(11kv/33kv) : --------------------------do---------------------------
7. Busduct/Rising Mains (sand with bus duct) : Siemens/Schneider/ABB/SPC Electrotech
8. Current Transformer(C.T.) : Siemens/Kappa/Anant Power
9. Potential Transformer(P.T.) : Siemens/Kappa/Anant Power
10. Bus Bar supports/Insulator : Siemens/Schneider /Anant Power
11. FRLS Copper Conductor Wire : ANCHOR / SKYTONE / KEI
12. Modular Switch Sockets : LEGRAND / ANCHOR / CRABTREE
13. MCB / ELCB / Double Door DB : LEGRAND / ANCHOR / SEIMENS
15. Light Fixtures : WIPRO / BAJAJ / CROMPTON
16. Telephone & TV Wire : RRKABEL / SKYTONE / DELTON
17. Telephone TAG Block : KRONE
18. CAT-6 Cable : D-LINK / AT&T / LEGRAND
19. RJ-45 Data Sockets : D-LINK / AT&T / LEGRAND
20. Fire Alarm : NOTIFIER / CEASEFIRE / AGNI
21. ISI marked rigid PVC pipe : Diplast , Precision, Polycab, Atul ( Medium quality)
22. ISI marked MS conduit pipe : AKG, BEC, NIC, ATUL
( Medium quality)

23. ISI marked wire and Cable with copper conductor with fire retarded insulation. : Finolex, Polycab, ASPL, Havells

24. ISI marked Piano Type Switches & ISI marked Modular Switch and sockets : Anchor, Precision, SSK, Adhunik, legrand

25. ISI marked Button holder, Ceiling Rose, Bell : Anchor, SSK, Precision, Vinay.

26. PVC Junction Box : Any ISI marked

27. Bakelite Sheets : Formica, Starlam, Hylam, Super Hylem

28. LT Panel, Air insulated busduct, Rising Mains : Conquerent, Adlec, Tricolite

29. Prewired distribution boards, sheet steel enclosures, MCB, DBs : Merlin Gerin, Adhunik, Hager

30. HT panels : Areva, Adhunik, Siemens