INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY (MAHARASTRA)

“Extension of CSRE building with Light Weight Roofing System for SINE inside IIT campus Powai, Mumbai–400 076.”

NIT NO.: IITB / Dean IPS / CACI / CSRE-SINE / 2018 / 15 Dated – 20/08/2018

TECHNICAL BID

VOLUME – II TECHNICAL SPECIFICATION
B – MEP WORKS

Issued to M/s. _________________________________

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## Technical Specification

### Volume – 2

#### Contents

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>General Note</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>List of Bureau of Indian Standards Codes</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Electrical</td>
<td>3</td>
</tr>
<tr>
<td>b.</td>
<td>Plumbing Health Works</td>
<td>4</td>
</tr>
<tr>
<td>c.</td>
<td>Fire Fighting &amp; Fire Protection</td>
<td>11</td>
</tr>
<tr>
<td>3.</td>
<td>Section B: Electrical Work</td>
<td>13</td>
</tr>
<tr>
<td>4.</td>
<td>Section C: Plumbing Work</td>
<td>48</td>
</tr>
<tr>
<td>5.</td>
<td>Section E: Fire Protection System</td>
<td>94</td>
</tr>
<tr>
<td>6.</td>
<td>Section F: HVAC Work &amp; IBMS Works</td>
<td>103</td>
</tr>
<tr>
<td>7.</td>
<td>Appendix “A” - List of Approved Make of Materials</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Electrical Work</td>
<td>158</td>
</tr>
<tr>
<td>b.</td>
<td>Public Health Work</td>
<td>162</td>
</tr>
<tr>
<td>c.</td>
<td>Fire Fighting Work</td>
<td>165</td>
</tr>
<tr>
<td>d.</td>
<td>HVAC Work</td>
<td>166</td>
</tr>
<tr>
<td>e.</td>
<td>Fire Alarm System</td>
<td>167</td>
</tr>
<tr>
<td>9.</td>
<td>Schedule of Technical Data</td>
<td>182</td>
</tr>
</tbody>
</table>
TECHNICAL SPECIFICATIONS

GENERAL

i. The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein & shall be guidance for proper execution of work to the required standards.

ii. It may also be noted that the specification are of generalized nature & these shall be read in conjunction with the description of item in schedule of quantities & drawings. The work also includes all minor details of construction which are obviously & fairly intended & which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.

iii. Unless specifically otherwise mentioned, all the applicable codes & standards published by the Indian standard Institution & all other standard which may be published by them before the date of receipt of tenders, shall govern in all respects of dosing workmanship quality & propitious of materials & methods of testing, method of measurements etc. Wherever any reference to any Indian Standard specifications occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued to or revisions thereof, if any, up to the date of receipt of tenders.

iv. In case there is no I.S.I specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, & requirements of the Engineers-in-Charge. Wherever any reference to any Indian standard specification occurs in the documents relating to this contract, the same shall be inclusive of all amendment issued there to or revisions thereof, if any, up to the date of receipt of tenders.

v. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.

vi. Samples of various materials, fitting etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineers-in-Charge before order for bulk supply is placed.

vii. The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.

viii. The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased delivery is contemplated, this provision shall apply to each Phase.

ix. The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted & nothing extra whatsoever shall be payable to the contractor for the test.

x. The contractor shall clear the site thoroughly of all scaffolding materials & rubbish etc. left out of his work & dress the site around the building to the satisfactions & his decision in writing shall be final & binding on all concerned.

xi. Post construction inspection and testing: After completion of the work and during maintenance period liability of the contractor, the work shall also be subjected to 'Post construction inspection and testing'. In case the materials or articles incorporated in the work are found to be inferior, though the sample collected for the same might have been passed at the time of execution, it shall be the responsibility of the contractor to replace the same at his own cost, failing which the Department may rectify the same at the risk and cost of the contractor or Department may
accept the work as sub-standard, and cost be adjusted from the outstanding security deposit, as per the terms and conditions of the contract for the work.

xii. The Dean (I.P.S.), shall be the sole deciding authority as to the meaning, interpretations and implications for various provisions of the specifications and his decision in writing shall be final and binding on all concerned.

xiii. In case any different or discrepancy between the specification & the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy between specification & drawing, the specification shall take precedence.
II – LIST OF INDIAN STANDARDS:

Following are the various pertinent Indian Standards, relevant to buildings work:
(All Latest Versions of I.S. codes shall be referred)

<table>
<thead>
<tr>
<th>I. S. CODE NO.</th>
<th>SUBJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS : 374</td>
<td>Ceiling fans and regulators (3rd revision)</td>
</tr>
<tr>
<td>IS : 694</td>
<td>PVC insulated Electric cable for working voltage upto and including 1100 volts.</td>
</tr>
<tr>
<td>IS : 732</td>
<td>Code of practice for electrical wiring and installation</td>
</tr>
<tr>
<td>IS : 1293</td>
<td>Three pin plugs and sockets outlets rated voltage upto and including 250 volts and rated current upto and including 160 amps.</td>
</tr>
<tr>
<td>IS : 1554 (Part - I)</td>
<td>PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.</td>
</tr>
<tr>
<td>IS : 1885</td>
<td>Glossary of items for electrical cables and conductors</td>
</tr>
<tr>
<td>IS : 1913</td>
<td>General and safety requirements for fluorescent lamps luminaries Tubular.</td>
</tr>
<tr>
<td>IS : 2309</td>
<td>Protection of building and allied structures against lightning</td>
</tr>
<tr>
<td>IS : 2551</td>
<td>Danger notice plate</td>
</tr>
<tr>
<td>IS : 3043</td>
<td>Code of practice for earthing</td>
</tr>
<tr>
<td>IS : 3427</td>
<td>AC Metal enclosed switch gear and control gear for rated voltages above 1 KV and upto and including 52 KV.</td>
</tr>
<tr>
<td>IS : 3480</td>
<td>Flexible steel conduits for electrical wiring.</td>
</tr>
<tr>
<td>IS : 3837</td>
<td>Accessories for rigid steel conduit for electrical wiring.</td>
</tr>
<tr>
<td>IS : 4146</td>
<td>Application guide for voltage transformers</td>
</tr>
<tr>
<td>IS : 4615</td>
<td>Switch socket outlets</td>
</tr>
<tr>
<td>IS : 5133 (Part - I)</td>
<td>Boxes for the enclosure of electrical accessories.</td>
</tr>
<tr>
<td>IS : 5216 (Part-I)</td>
<td>Guide for safety procedures and practices in electrical work.</td>
</tr>
<tr>
<td>IS : 5424</td>
<td>Rubber mats for electrical purposes.</td>
</tr>
<tr>
<td>IS : 5578 &amp; 11353</td>
<td>Marking and arrangement of bus bars</td>
</tr>
<tr>
<td>IS : 8130</td>
<td>Conductors for insulated electric cables and flexible cords</td>
</tr>
<tr>
<td>IS : 8828</td>
<td>Miniature Circuit Breakers</td>
</tr>
<tr>
<td>IS : 9537</td>
<td>Rigid Steel Conduits for electrical wiring (Second Revisions)</td>
</tr>
<tr>
<td>IS : 10810</td>
<td>Methods of test for cables.</td>
</tr>
<tr>
<td>IS Code</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>12640</td>
<td>IS : 12640  Earth Leakage Circuit Breakers</td>
</tr>
<tr>
<td>13947</td>
<td>IS : 13947  Moulded Case Circuit Breakers</td>
</tr>
<tr>
<td>13947</td>
<td>IS : 13947  Degree of protection provided by enclosures for LV switchgear and control gear.</td>
</tr>
<tr>
<td>13947</td>
<td>IS : 13947  General requirement for switchgear and control gear for voltage not exceeding 1000 Volts.</td>
</tr>
<tr>
<td>15652</td>
<td>IS : 15652  Insulating materials for electrical purposes.</td>
</tr>
<tr>
<td>1651 &amp; 1652</td>
<td>IS : 1651 &amp; 1652 Stationary cells and batteries lead acid type.</td>
</tr>
</tbody>
</table>

**I. S. CODE NO.**

**SECTION “C” – PUBLIC HEALTH WORKS**

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Reaffirmation</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>27-1992</td>
<td>Reaffirmed 2002</td>
<td>Specifications for Pig Lead</td>
</tr>
<tr>
<td>269-1989</td>
<td>Reaffirmed 2004</td>
<td>Specifications for 33 grade Ordinary Portland Cement</td>
</tr>
<tr>
<td>407-1981</td>
<td>Reaffirmed 2001</td>
<td>Brass tubes for General purposes</td>
</tr>
<tr>
<td>458-2003</td>
<td>-</td>
<td>Specifications for Concrete Pipes.</td>
</tr>
<tr>
<td>554-1999</td>
<td>-</td>
<td>Dimensions for pipe thread where pressure tight joints are required.</td>
</tr>
<tr>
<td>636-1988</td>
<td>Reaffirmed 2003</td>
<td>Fire fighting hose, rubber lined or fabric reinforced rubber lined woven -jacketed</td>
</tr>
<tr>
<td>638-1979</td>
<td>Reaffirmed 2003</td>
<td>Sheet rubber jointing &amp; rubber insertion jointing</td>
</tr>
<tr>
<td>771 (Pt. I &amp; VII)</td>
<td></td>
<td><strong>Glazed Fire Clay Sanitary Appliances.</strong></td>
</tr>
<tr>
<td>771-1979 (Pt. I)</td>
<td>Reaffirmed 2003</td>
<td>General requirements</td>
</tr>
<tr>
<td>771-1985 (Pt. II)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements of kitchen &amp; laboratory sinks</td>
</tr>
<tr>
<td>771-1979 (Pt. III/ Sec 1)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements of urinals (section 1-Slab urinals)</td>
</tr>
<tr>
<td>771-1985 (Pt. III/ Sec2)</td>
<td>Reaffirmed 2000</td>
<td>Specific requirements of urinals (section 2-Stall urinals)</td>
</tr>
<tr>
<td>771-1979 (Pt. IV)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements of postmortem slabs.</td>
</tr>
<tr>
<td>771-1979 (Pt. V)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements of shower trays</td>
</tr>
<tr>
<td>771-1979 (Pt. VI)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements of bed pan sinks</td>
</tr>
<tr>
<td>771-1981 (Pt. VII)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements of slop sinks</td>
</tr>
<tr>
<td>775-1970</td>
<td>Reaffirmed 2000</td>
<td>Cast iron brackets and supports for wash basin and sink.</td>
</tr>
<tr>
<td>778-1984</td>
<td>Reaffirmed 2000</td>
<td>Specifications for copper alloy gate &amp; Globe check valves for water works</td>
</tr>
<tr>
<td>779-1994</td>
<td>Reaffirmed 2004</td>
<td>Water meters (domestic type)</td>
</tr>
<tr>
<td>781-1984</td>
<td>Reaffirmed 2001</td>
<td>Specifications for cast copper alloy screw down bib taps &amp; stop cocks for water services</td>
</tr>
<tr>
<td>Specification</td>
<td>Date</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>784-2001</td>
<td>Reaffirmed 2002</td>
<td>Pre-stressed concrete pipes.</td>
</tr>
<tr>
<td>884-1985</td>
<td>Reaffirmed 2000</td>
<td>Fire aid hose reel for fire fighting (for fixed installation)</td>
</tr>
<tr>
<td>903-1993</td>
<td>Reaffirmed 2003</td>
<td>Couplings for fire hose delivery, branch pipe, nozzles specification</td>
</tr>
<tr>
<td>905-1980</td>
<td>Reaffirmed 2002</td>
<td>Specification for delivery breechings, dividing and collecting instantaneous pattern for Fire Fighting</td>
</tr>
<tr>
<td>908-1975</td>
<td>Reaffirmed 2000</td>
<td>Fire Hydrants, Stand post type</td>
</tr>
<tr>
<td>909-1992</td>
<td>Reaffirmed 2002</td>
<td>Specifications for underground fire hydrants, sluice valve type</td>
</tr>
<tr>
<td>940-1989</td>
<td>-</td>
<td>Portable Fire Extinguisher, water Type (Gas Cartridge) - Specification</td>
</tr>
<tr>
<td>1172-1993</td>
<td>Reaffirmed 2002</td>
<td>Code of basic requirements for water supply, drainage and sanitation</td>
</tr>
<tr>
<td>1200-1979 (Pt. 16)</td>
<td>Reaffirmed 2002</td>
<td>Method of measurements for Laying of water and sewer lines including appurtenant items.</td>
</tr>
<tr>
<td>1230</td>
<td></td>
<td>Specifications for CI Rain Water pipes</td>
</tr>
<tr>
<td>1239-2004 (Pt I)</td>
<td></td>
<td>Specifications for Mild steel tubes</td>
</tr>
<tr>
<td>1239-1992 (Pt. II)</td>
<td>Reaffirmed 2002</td>
<td>Specifications for Mild steel Tubular &amp; other wrought steel pipe fittings</td>
</tr>
<tr>
<td>1300-1994</td>
<td>Reaffirmed 2000</td>
<td>Phenolic moulding material specification</td>
</tr>
<tr>
<td>1536-2001</td>
<td>-</td>
<td>Specifications for Centrifugally cast iron (spun) pressure pipes for water, gas and sewage</td>
</tr>
<tr>
<td>1537-1976</td>
<td>Reaffirmed 2000</td>
<td>Specifications for Vertically cast iron pressure pipes for water, gas and sewage</td>
</tr>
<tr>
<td>1538-1993</td>
<td>Reaffirmed 1999</td>
<td>Cast iron fittings for pressure pipes for water, gas and sewage</td>
</tr>
<tr>
<td>1700-1973</td>
<td>Reaffirmed 2003</td>
<td>Drinking fountains</td>
</tr>
<tr>
<td>1701-1960</td>
<td>Reaffirmed 2003</td>
<td>Combination valve, mixing valves</td>
</tr>
<tr>
<td>1703-2000</td>
<td></td>
<td>Ball valve (horizontal plunger type) including floats for water supply.</td>
</tr>
<tr>
<td>Standard Number</td>
<td>Standard Reaffirmed Year</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>1729-2002</td>
<td></td>
<td>Cast/ductile iron drainage pipes &amp; fittings for over ground NP pipeline S/S series.</td>
</tr>
<tr>
<td>1795-1982</td>
<td>Reaffirmed 2000</td>
<td>Pillar taps for water supply purposes</td>
</tr>
<tr>
<td>1879</td>
<td></td>
<td>Malleable Cast Iron Pipe Fittings</td>
</tr>
<tr>
<td>1979-1985</td>
<td>Reaffirmed 2002</td>
<td>Specification for high test line pipe</td>
</tr>
<tr>
<td>2104-1981</td>
<td>Reaffirmed 2003</td>
<td>Water meter boxes (domestic type)</td>
</tr>
<tr>
<td>2171 – 1999</td>
<td></td>
<td>Specification for portable fire extinguisher, dry powder (Cartridge Type)</td>
</tr>
<tr>
<td>2267-1995</td>
<td>Reaffirmed 2000</td>
<td>Polystyrene moulding and extension materials – specification</td>
</tr>
<tr>
<td>2326-1987</td>
<td>Reaffirmed 2003</td>
<td>Automatic flushing cistern for urinals</td>
</tr>
<tr>
<td>2373</td>
<td></td>
<td>Specification for Water Meter (Bulk type)</td>
</tr>
<tr>
<td>2470 (Pt. I to II)</td>
<td></td>
<td>Code of practice for installation of septic tanks</td>
</tr>
<tr>
<td>2470-1985 (Pt. I)</td>
<td>Reaffirmed 2001</td>
<td>Design criteria &amp; construction</td>
</tr>
<tr>
<td>2470-1985 (Pt. II)</td>
<td>Reaffirmed 2001</td>
<td>Secondary Treatment &amp; disposal of septic tank effluent</td>
</tr>
<tr>
<td>2556 (Pt. 1 to XV)</td>
<td></td>
<td>Specification for Vitreous (Vitreous China) sanitary appliances.</td>
</tr>
<tr>
<td>2556-1994 (Pt.1)</td>
<td>Reaffirmed 2004</td>
<td>General requirements</td>
</tr>
<tr>
<td>2556-1994 (Pt.2)</td>
<td>Reaffirmed 1999</td>
<td>Specific requirements of wash down water-closets</td>
</tr>
<tr>
<td>2556-2004 (Pt.3)</td>
<td></td>
<td>Specific requirements of squatting pans</td>
</tr>
<tr>
<td>2556-2004 (Pt. 4)</td>
<td></td>
<td>Specific requirements of wash basins</td>
</tr>
<tr>
<td>2556-1994 (Pt.5)</td>
<td>Reaffirmed 2004</td>
<td>Specific requirements of laboratory sinks</td>
</tr>
<tr>
<td>2556-1995(Pt.6)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements of urinals &amp; partition plate</td>
</tr>
<tr>
<td>2556-1995 (Pt.7)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements of accessories for sanitary appliances</td>
</tr>
<tr>
<td>Code</td>
<td>Reaffirmed</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2556-1995 (Pt.8)</td>
<td>Reaffirmed 1998</td>
<td>Specific requirements of pedestal close coupled &amp; wash down and siphonic water closets</td>
</tr>
<tr>
<td>2556-2004 (Pt.9)</td>
<td>-</td>
<td>Specific requirements of pedestal type bidets</td>
</tr>
<tr>
<td>2800-1991 (Pt. I)</td>
<td>-</td>
<td>Construction of tube well</td>
</tr>
<tr>
<td>2800-1979 (Pt. II)</td>
<td>-</td>
<td>Testing of tube well</td>
</tr>
<tr>
<td>2871-1983</td>
<td>Reaffirmed 2000</td>
<td>Specification for Branch pipe, universal, for fire fighting purposes</td>
</tr>
<tr>
<td>2878-2004</td>
<td>-</td>
<td>Fire Extinguisher, Carbon Dioxide Type (Portable and Trolley Mounted) – Specification.</td>
</tr>
<tr>
<td>2951 (Pt. I to II)</td>
<td>-</td>
<td>Recommendation for estimate of flow of liquids in closed conduits.</td>
</tr>
<tr>
<td>2951-1965 (Pt. I)</td>
<td>Reaffirmed 2003</td>
<td>Head loss in straight pipes due to frictional resistance</td>
</tr>
<tr>
<td>3006-1979</td>
<td>Reaffirmed 2003</td>
<td>Specification for Chemically resistant glazed S.W. pipes and Fitting</td>
</tr>
<tr>
<td>3076-1985</td>
<td>Reaffirmed 2003</td>
<td>Low density polyethylene pipes for potable water supply</td>
</tr>
<tr>
<td>3328-1993</td>
<td>Reaffirmed 2003</td>
<td>Quality tolerances for water for swimming pools</td>
</tr>
<tr>
<td>3389-1994</td>
<td>Reaffirmed 2000</td>
<td>Urea formaldehyde moulding materials</td>
</tr>
<tr>
<td>3486-1966</td>
<td>Reaffirmed 2000</td>
<td>Specification for Cast iron spigot and socket drain pipes</td>
</tr>
<tr>
<td>3489-1985</td>
<td>Reaffirmed 2000</td>
<td>Specifications for eameled steel bath tubs</td>
</tr>
<tr>
<td>3589-2001</td>
<td>-</td>
<td>Specifications for steel pipes for water &amp; sewage (168.3 to 2540 mm outside dia.)</td>
</tr>
<tr>
<td>3989-1984</td>
<td>Reaffirmed 2000</td>
<td>Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings &amp; accessories.</td>
</tr>
<tr>
<td>4038-1986</td>
<td>Reaffirmed 2000</td>
<td>Foot valves for water works purposes.</td>
</tr>
<tr>
<td>4111 (Pt. I to V)</td>
<td>-</td>
<td>Code of practice for ancillary structures in sewage system.</td>
</tr>
<tr>
<td>4111-1986 (Pt. I)</td>
<td>Reaffirmed 2001</td>
<td>Manholes</td>
</tr>
<tr>
<td>4111-1985 (Pt. II)</td>
<td>Reaffirmed 2001</td>
<td>Flushing tanks</td>
</tr>
<tr>
<td>4111-1985 (Pt. III)</td>
<td>Reaffirmed 2001</td>
<td>Inverted syphon</td>
</tr>
<tr>
<td>4111-1968 (Pt. IV)</td>
<td>Reaffirmed 2001</td>
<td>Pumping stations &amp; pumping mains (rising mains)</td>
</tr>
<tr>
<td>4111-1993 (Pt. V)</td>
<td>Reaffirmed 2004</td>
<td>Tidal out-falls</td>
</tr>
<tr>
<td>Code of Practice</td>
<td>Reaffirmed Year</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>4733-1972</td>
<td>Reaffirmed 1992</td>
<td>Methods of sampling &amp; test for sewage effluents</td>
</tr>
<tr>
<td>4854 (Pt. I to III)</td>
<td>-</td>
<td>Glossary terms for valves and their parts</td>
</tr>
<tr>
<td>4854-1969 (Pt. I)</td>
<td>Reaffirmed 1999</td>
<td>Screw down stop, check &amp; gate valves &amp; their parts</td>
</tr>
<tr>
<td>4854-1968 (Pt. II)</td>
<td>Reaffirmed 1999</td>
<td>Plug valves &amp; cocks &amp; their parts</td>
</tr>
<tr>
<td>4854-1974 (Pt. III)</td>
<td>Reaffirmed 1999</td>
<td>Butterfly valves</td>
</tr>
<tr>
<td>4927-1992</td>
<td>Reaffirmed 2002</td>
<td>Unlined flax canvass hose for fire fighting</td>
</tr>
<tr>
<td>4984-1995</td>
<td>Reaffirmed 2002</td>
<td>Specifications for HDPE pipes for water supply</td>
</tr>
<tr>
<td>4985-2000</td>
<td>-</td>
<td>Specifications for unplasticised PVC pipes for potable water supplies</td>
</tr>
<tr>
<td>5312 (Pt. I)</td>
<td>-</td>
<td>Swing check type reflux (non return ) valves</td>
</tr>
<tr>
<td>5312-1984 (Pt. I)</td>
<td>Reaffirmed 2000</td>
<td>Reflux (non return ) valves – single door pattern</td>
</tr>
<tr>
<td>5329-1983</td>
<td>Reaffirmed 2001</td>
<td>Code of Practice for sanitary pipe work above ground for building</td>
</tr>
<tr>
<td>5382-1985</td>
<td>Reaffirmed 2003</td>
<td>Specifications for rubber sealing rings for water, gas &amp; sewer mains</td>
</tr>
<tr>
<td>5455-1969</td>
<td>Reaffirmed 2003</td>
<td>Cast iron steps for manholes</td>
</tr>
<tr>
<td>5600-2002</td>
<td>-</td>
<td>Specifications for Sewage and drainage pumps</td>
</tr>
<tr>
<td>5611-1987</td>
<td>Reaffirmed 2002</td>
<td>Code of Practice for waste stabilization ponds (Facultative type)</td>
</tr>
<tr>
<td>5714-1981</td>
<td>Reaffirmed 2002</td>
<td>Specifications for Hydrant stand-pipe for fire fighting</td>
</tr>
<tr>
<td>5822-1994</td>
<td>Reaffirmed 2004</td>
<td>Code of Practice for laying of welded steel pipes for water supply</td>
</tr>
<tr>
<td>5961-1970</td>
<td>Reaffirmed 2003</td>
<td>Specifications for Cast Iron grating for drainage purposes</td>
</tr>
<tr>
<td>6234 -2003</td>
<td>-</td>
<td>Portable fire Extinguisher water Type (Stored Pressure) – Specification.</td>
</tr>
<tr>
<td>6279-1971</td>
<td>Reaffirmed 2001</td>
<td>Equipment for grit removal</td>
</tr>
<tr>
<td>6280-1971</td>
<td>Reaffirmed 2001</td>
<td>Sewage screens</td>
</tr>
<tr>
<td>6295-1986</td>
<td>Reaffirmed 2001</td>
<td>COP for water supply &amp; drainage in high altitude &amp; / or subzero region</td>
</tr>
<tr>
<td>6392-1971</td>
<td>Reaffirmed 1998</td>
<td>Steel pipe flanges</td>
</tr>
<tr>
<td>6411-1985</td>
<td>Reaffirmed 2000</td>
<td>Specifications for gel coated glass fiber reinforced polyester resin bath tubs</td>
</tr>
<tr>
<td>6418-1971</td>
<td>Reaffirmed 2000</td>
<td>Cast Iron &amp; malleable flanges for general engg. Purpose</td>
</tr>
<tr>
<td>6494-1988</td>
<td>Reaffirmed 2000</td>
<td>COP for water proofing of under ground water tanks &amp; swimming</td>
</tr>
<tr>
<td>Standards</td>
<td>Reaffirmed Year</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>6587-1987</td>
<td>Reaffirmed 2003</td>
<td>Specifications for Spun hemp yarn</td>
</tr>
<tr>
<td>7231-1994</td>
<td>Reaffirmed 2004</td>
<td>Specifications for Plastic Flushing Cisterns for w.c. &amp; urinals</td>
</tr>
<tr>
<td>7558-1974</td>
<td>Reaffirmed 2001</td>
<td>Code of Practice for domestic hot water installations</td>
</tr>
<tr>
<td>7634 (Pt. I to III)</td>
<td>Reaffirmed 2002</td>
<td>Code of Practice for Plastic pipe work for potable water supplies</td>
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<td>7634-1979 (Pt. II)</td>
<td>Reaffirmed 2002</td>
<td>Laying &amp; jointing polyethylene (PE) pipes</td>
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<tr>
<td>7634-2003 (Pt. III)</td>
<td>-</td>
<td>Laying &amp; jointing unplasticised PVC pipes</td>
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<td>7740-1985</td>
<td>Reaffirmed 2001</td>
<td>Code of Practice for road gullies</td>
</tr>
<tr>
<td>7834 (Pt. I to VIII)</td>
<td>Reaffirmed 2003</td>
<td>Injection moulded PVC socket fittings with solvent cement joints for water supplies</td>
</tr>
<tr>
<td>7834-1987 (Pt. I)</td>
<td>Reaffirmed 2003</td>
<td>General requirements</td>
</tr>
<tr>
<td>7834-1987 (Pt. II)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements for 45° elbows</td>
</tr>
<tr>
<td>7834-1987 (Pt. III)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements for 90° elbows</td>
</tr>
<tr>
<td>7834-1987 (Pt. IV)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements for 90° tees</td>
</tr>
<tr>
<td>7834-1987 (Pt. V)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements for 45° tees</td>
</tr>
<tr>
<td>7834-1987 (Pt. VI)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements for sockets</td>
</tr>
<tr>
<td>7834-1987 (Pt. VII)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements for unions</td>
</tr>
<tr>
<td>7834-1987 (Pt. VIII)</td>
<td>Reaffirmed 2003</td>
<td>Specific requirements for caps</td>
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<td>Injection moulded HDPE fittings for potable water supplies</td>
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<td>Specific requirements for 90° bends</td>
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<td>8008-2003 (Pt. III)</td>
<td>-</td>
<td>Specific requirements for 90° tees</td>
</tr>
<tr>
<td>8008-2003 (Pt. IV)</td>
<td>-</td>
<td>Specific requirements for reducers</td>
</tr>
<tr>
<td>8008-2003 (Pt. V)</td>
<td>-</td>
<td>Specific requirements for ferrule reducers</td>
</tr>
<tr>
<td>8008-2003 (Pt. VI)</td>
<td>-</td>
<td>Specific requirements for pipe ends</td>
</tr>
<tr>
<td>8008-2003 (Pt. VII)</td>
<td>-</td>
<td>Specific requirements for sandwich flanges</td>
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<td>8090-1976</td>
<td>Reaffirmed 2000</td>
<td>Coupling, branch pipe, nozzle used in hose reel tubing for fire fighting</td>
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<td>8329-2000</td>
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<td>Centrifugally cast (spun) ductile iron pressure pipes &amp; fittings for water, gas &amp; sewage</td>
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<td>8413 (Pt. I)</td>
<td>Reaffirmed 2001</td>
<td>Requirements for biological treatment equipment</td>
</tr>
<tr>
<td>8413-1977 (Pt. I)</td>
<td>Reaffirmed 2001</td>
<td>Trickling Filter</td>
</tr>
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<td>8718-1978</td>
<td>Reaffirmed 2000</td>
<td>Specifications for vitreous enameled steel kitchen sinks</td>
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<td>8727-1987</td>
<td>Reaffirmed 2000</td>
<td>Specifications for vitreous enameled steel wash basin</td>
</tr>
<tr>
<td>Standard Number</td>
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</tr>
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<td>8835-1978</td>
<td>Reaffirmed 1999</td>
<td>Guideline for planning and design of surface drains.</td>
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<td>8931-1993</td>
<td>Reaffirmed 2003</td>
<td>Specifications for copper alloys Fancy single taps, combination tap assembly &amp; stop valves for water services</td>
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<tr>
<td>9140-1996</td>
<td>Reaffirmed 2002</td>
<td>Method of sampling of vitreous &amp; fire clay sanitary appliances</td>
</tr>
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<td>9293-1991</td>
<td>Reaffirmed 1996</td>
<td>Specifications for flax canvas</td>
</tr>
<tr>
<td>9338-1984</td>
<td>Reaffirmed 2000</td>
<td>Specifications for Cast Iron screw down stop valves and stop &amp; check valves for water works purposes</td>
</tr>
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<td>9758-1981</td>
<td>Reaffirmed 2003</td>
<td>Flush valves and Fittings for water closets and urinals</td>
</tr>
<tr>
<td>9762-1994</td>
<td>Reaffirmed 2004</td>
<td>Specifications for polyethylene floats for float valves</td>
</tr>
<tr>
<td>10221-1982</td>
<td>Reaffirmed 1997</td>
<td>Code of practice for coating and wrapping of underground M.S. steel pipeline,</td>
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<tr>
<td>11189-1985</td>
<td>Reaffirmed 2000</td>
<td>Method of tube well development</td>
</tr>
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<td>11632 -1986</td>
<td>Reaffirmed 2000</td>
<td>Rehabilitation of Tube well</td>
</tr>
<tr>
<td>12235 -1986</td>
<td>Reaffirmed 1998</td>
<td>Method of test for UPVC pipe for potable water supply</td>
</tr>
<tr>
<td>12469 -1988</td>
<td>Reaffirmed 2002</td>
<td>Specifications for pumps</td>
</tr>
<tr>
<td>12592-2002</td>
<td>Reaffirmed 2002</td>
<td>Precast concrete frame &amp; cover ( SFRC frame &amp; cover )</td>
</tr>
<tr>
<td>12701-1996</td>
<td>Reaffirmed 2002</td>
<td>Specifications for rotational moulded polyethylene water storage tanks</td>
</tr>
<tr>
<td>12818 -1992</td>
<td>Reaffirmed 2002</td>
<td>Spn. for UPVC ribbed screen casing &amp; plain casing pipes for bore / tube well</td>
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<tr>
<td>13095 -1991</td>
<td>Reaffirmed 2003</td>
<td>Butterfly valves for general purposes</td>
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<tr>
<td>IS No.</td>
<td>Reaffirmed Year</td>
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<td>13114-1991</td>
<td>Reaffirmed 2003</td>
<td>Spn. for forged brass gate, globe &amp; check valves for water works purposes</td>
</tr>
<tr>
<td>13382-2004</td>
<td></td>
<td>Cast Iron specials for mechanical &amp; push-on flexible joints for pressure pipelines for water, gas &amp; sewage</td>
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<tr>
<td>13983-1994</td>
<td>Reaffirmed 2004</td>
<td>Specifications for stainless steel kitchen sinks &amp; drain boards for domestic purpose</td>
</tr>
<tr>
<td>14845-2000</td>
<td>Reaffirmed 2004</td>
<td>Resilient seated cast iron air relief valves for water works purposes – Spn</td>
</tr>
<tr>
<td>14846-2000</td>
<td></td>
<td>Specifications for sluice valve for water works purposes (50 to 1200 mm size)</td>
</tr>
<tr>
<td>15265 – 2003</td>
<td></td>
<td>Specifications for flexible PVC pipes or polymer reinforcement thermo plastic hoses for suction and delivery lines for Agricultural pumps.</td>
</tr>
<tr>
<td>15328 – 2003</td>
<td></td>
<td>UPVC non pressure pipes for use in underground drainage and sewerage system – Specifications.</td>
</tr>
</tbody>
</table>

**SECTION “D – FIRE FIGHTING & FIRE PROTECTION**

<table>
<thead>
<tr>
<th>I. S. Code No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBC Part – IV</td>
<td>National Building Code of India; Part IV Fire &amp; Life Safety</td>
</tr>
<tr>
<td>TAC</td>
<td>Tariff Advisory Committee fire protection manual Part-I.</td>
</tr>
<tr>
<td>TAC</td>
<td>Rules of Tariff Advisory Committee for automatic sprinkler system.</td>
</tr>
<tr>
<td>NFPA : 13</td>
<td>Installation of Sprinkler System</td>
</tr>
<tr>
<td>NFPA : 14</td>
<td>Installation of Standpipe &amp; Hose System</td>
</tr>
<tr>
<td>NFPA : 20</td>
<td>Installation of Stationary pump for Fire Protection</td>
</tr>
<tr>
<td>IS : 636</td>
<td>Non-percolating flexible fire fighting delivery hose.</td>
</tr>
<tr>
<td>IS : 884</td>
<td>Specification for first aid hose reel for fire fighting.</td>
</tr>
<tr>
<td>IS : 901</td>
<td>Specification for couplings, double male and double female, instantaneous pattern for fire fighting.</td>
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<td>IS</td>
<td>Description</td>
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<tr>
<td>IS : 902</td>
<td>Suction hose couplings for fire fighting purposes.</td>
</tr>
<tr>
<td>IS : 903</td>
<td>Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner.</td>
</tr>
<tr>
<td>IS : 904</td>
<td>Specification for 2-way and 3-way suction collecting heads for fire fighting purposes.</td>
</tr>
<tr>
<td>IS : 907</td>
<td>Specification for suction strainers, cylindrical type for fire fighting purposes.</td>
</tr>
<tr>
<td>IS : 908</td>
<td>Specification for fire hydrant, stand post type.</td>
</tr>
<tr>
<td>IS : 909</td>
<td>Specification for underground fire hydrant, sluice valve type.</td>
</tr>
<tr>
<td>IS : 910</td>
<td>Specification for portable chemical foam fire extinguisher.</td>
</tr>
<tr>
<td>IS : 933</td>
<td>Specification for portable chemical foam fire extinguisher.</td>
</tr>
<tr>
<td>IS : 2171</td>
<td>Specification for portable fire extinguishers dry powder (cartridge type)</td>
</tr>
<tr>
<td>IS : 2190</td>
<td>Selection, installation and maintenance of first aid fire extinguishers – Code of practice.</td>
</tr>
<tr>
<td>IS : 2871</td>
<td>Specification for branch pipe, universal, for fire fighting purposes.</td>
</tr>
<tr>
<td>IS : 2878</td>
<td>Specification for fire extinguishers, carbon dioxide type (portable and trolley mounted).</td>
</tr>
<tr>
<td>IS : 3844</td>
<td>Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises.</td>
</tr>
<tr>
<td>IS : 5290</td>
<td>Specification for landing valves.</td>
</tr>
<tr>
<td>IS : 5714</td>
<td>Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting.</td>
</tr>
<tr>
<td>IS : 8423</td>
<td>Specification for controlled percolation type hose for fire fighting.</td>
</tr>
<tr>
<td>IS : 10658</td>
<td>Specification for higher capacity dry powder fire extinguisher (trolley mounted).</td>
</tr>
<tr>
<td>IS : 11460</td>
<td>Code of practice for fire safety of libraries and archives buildings.</td>
</tr>
<tr>
<td>IS : 5514</td>
<td>Reciprocating internal combustion engines : Performance.</td>
</tr>
<tr>
<td>(Parts 1 to 7)</td>
<td></td>
</tr>
</tbody>
</table>
1. INTERNAL WIRING

1.1 System of Wiring

The system of wiring shall consist of PVC insulated copper stranded conductor flexible FRLS wires in metallic / non metallic (Rigid heavy Duty ISI -marked fire retarded FRST PVC Conduits of minimum 2mm Wall thickness and Sizes starting from 20 mm diameter) conduits and shall be concealed or surface mounted above false ceiling as called for.

1.2 General

Prior to laying and fixing of conduits, the contractor shall mark the conduit route, carefully examine the working drawings prepared by him and approved by the Consultant indicating the layout, satisfy himself about the non interference in the route, sufficiency of number and sizes of conduits, location of junction boxes, sizes and location of switch boxes and other relevant details. Any discrepancy found shall be brought to the notice of the Owner's site representative. Any modifications suggested by the contractor should get written approval before the actual laying of conduits is commenced.

In laying of conduits it is important that not more than two right angle bends are provided for each circuit without a pull box. No junction box shall be provided in the entire length of conduit run for drawing of wires. Only switch outlets, lighting fixture outlets, equipment power outlets and socket outlets shall be considered for drawing of wires.

1.3 Metal Conduits & Accessories

1.3.1 Conduits

Conduits and Accessories shall conform to latest edition of Indian Standards IS-9537 part 1 & 2. 16/14 (16 gauge upto 32mm diameter & 14 gauge above 32 mm diameter) gauge screwed GI or MS painted conduits as specified on schedule of quantities shall be used. Joints between conduits and accessories shall be securely made by standard accessories, as per IS-2667, IS-3837 and IS-5133 to ensure earth continuity. All conduit accessories shall be threaded type only.

Only approved make of conduits and accessories shall be used.

Conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

Note: Whatever materials required to be billed by the Contractor should come on site with proper Challan Numbers and quantity mentioned in each such Challan.

1.3.2 Joints

All jointing shall be subject to the approval of the Owner's site representative. The threads and sockets shall be free from grease and oil. End termination of conduit on GI boxes shall be by means of hexagon check nuts & spring washer on both sides of the conduit. The joints in conduits shall be free of burrs to avoid damage to insulation of conductors while pulling them through the conduits. Rubberised bushes shall be used in the conduit entry and exit from DBs, switch boxes etc., so that wires are protected from damage to insulation of the incoming and outgoing wires.
1.3.3 **Recessed or Exposed Conduits**

All conduits shall be as per Schedule of Quantities.

1.3.4 **Flexible Conduits**

Flexible conduits shall be made of heavy gauge MS strip galvanized after making the spiral. Both edges of the strip to have interlocking to avoid opening up. Flexible conduit shall be heat resistant, lead coated steel, water leak, fire and rust proof. The flexible conduit shall be heat resistant on continuous temperature up to 150 deg. C and intermittent temperature up to 200 deg. C. The flexible conduit shall be corrosion resistant as per IS-3480 & BS-731.

1.4 **PVC Conduit and Accessories**

**PVC Conduit**

Conduits and accessories shall conform to latest edition of IS-9537 part 3 and shall be heavy duty with minimum wall thickness of 2.0 mm rigid tubes which are unscrewed without coupling and with plain ends. All conduits used shall be ISI-marked and shall not be less than 20 mm diameter.

PVC conduit shall be used for all concealed / embedded installation.

**PVC Conduit Accessories**

Accessories used for conduit shall be of an approved brand and type complying to relevant IS code.

All accessories used shall be of standard white or black colour, identical to conduit used.

Plain conduits shall be jointed by slip type of couplers with manufacturer’s standard sealing cement.

All conduit entries to outlet boxes, trunking and switchgear are to be made with adaptors female thread and screwed male bushes.

PVC-switch and socket boxes with round knockouts are to be used. The colours of these boxes and the conduits shall be the same.

Standard PVC circular junction boxes are to be used with conduits for intersection, Tee-junction, angle-junction and terminal. For the drawing-in of cables, standard circular through boxes shall be used.

Samples of accessories shall be submitted for approval prior to installation.

All jointing of PVC conduits shall be by means of adhesive jointing. Adequate expansion joints shall be allowed to take up the expansion of PVC conduits.

1.5 **Bends in Conduit**

Where necessary, bends or diversions may be achieved by means of bends and / or circular cast iron boxes with inspection cover and with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with the finished wall surface. No bends shall have radius less than 7.5 cms or three times the outside diameter of the conduits. For metallic conduits, bends of defined radius shall be made by compactly filling fine sand inside the conduit length, to avoid non-uniform shape, once the bend is done. Proper jigs shall be used to ensure that the Enameling / Galvanising of
the Conduit is not damaged.

1.6 Fixing of Conduits
All conduits shall be installed so as to avoid exposure to steam, hot water or any other process pipes. After the conduits, junction boxes, outlet boxes and switch boxes are installed in position, their outlets shall be properly plugged or covered so that water, mortar, rodents and insects, insects or any other foreign matter does not enter into the conduit system. Surface conduits shall be fixed by means of heavy gauge GI saddles secured on 5mm thick GI spacers at intervals not more than 1000 mm, and on either side of couplers or bends or similar fitting saddles shall be fixed at a distance of 300 mm from centre of each fitting. For conduit fixing suitable PVC/Nylon fasteners shall be used.

Recessed conduiting shall be done by making chase in the masonry by chase cutter, the conduit shall be fixed in the chase by means of GI hooks not more than 600 mm apart. After fixing of conduit the chase shall be filled with cement mortar after fixing of chicken mesh and brought to the original finish level of the surface to the entire satisfaction of Owner.

1.7 Switch outlets and Junction Boxes
All outlet boxes for switches, sockets and other receptacles shall be rust proof and shall be of 1.6 mm thick mild steel sheets with HOT dipped galvanizing (or as specified in SOQ), having smooth external and internal surfaces to true finish. All outlet boxes for receiving plug sockets and switches shall be fabricated to approved sizes. All boxes shall have adequate number of knock out holes of required diameter and earthing terminal screws. Outlet boxes shall generally be of 50mm depth subject to maximum depth of 65 mm.

1.8 Inspection Boxes
50 mm dia inspection boxes and pull boxes shall have smooth external and internal finish to facilitate removal and replacement of wires, where required.

1.9 Fish Wire
To facilitate subsequent drawing of wires in the conduit, GI fish wires of 2.0 mm (14 SWG) shall be provided alongwith the laying of recessed conduit.

1.10 Conductors
All PVC insulated copper conductor flexible FRLS, as specified in SOQ, wires shall conform in all respects to Standards as listed under sub-head Indian Standards and shall be IS approved and ISI marked.

1.11 Bunching of Wires
Wires carrying current shall be so bunched that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not run in the same conduit. All wires shall have ferrules for identification. Lighting and power circuits shall be separate. Each Power/ Light Circuit’s Neutral shall be individual per Circuit and shall not be looped from any other Circuit.

1.12 Drawing Conductors
The drawing and jointing of PVC insulated copper conductor wires shall be executed with due regard to the following precautions. While drawing wires through conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends. Wire reel stands to be used for pulling of wires to avoid kinks. Care shall be exercised while drawing the wires from reels, by taking appropriate measures to ensure that wires are not spread on ground, causing dust and dirt accumulation on the new wires.
Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn into metallic Conduits are given below:

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<th>Size of wires Nominal Cross section Area (Sq. mm.)</th>
<th>Maximum number of wires within conduit size(mm)</th>
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Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn into rigid non metallic or PVC Conduits are given below:

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</table>

Insulation shall be removed by insulation stripper only. Few Strands of wires shall not be cut/reduced for convenience in connecting into terminals. The terminals shall have sufficient cross sectional area to take all strands and it’s connecting brass screws shall have flats ends. All looped joints shall be connected through terminal block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. All light points shall be terminated through a connector.

Condutors having nominal cross sectional areas exceeding 10 sq.mm shall always be provided with cable sockets. At all bolted terminals brass flat washer of large area and approved steel spring washer shall be used. Brass nuts and bolts with brass washers shall be used for all connections.

Only licensed wiremen (Before doing the work or before appointing him on site contractor has to submit his wiring licence to Owner) and cable jointers shall be employed to do jointing work. Before entrusting cable jointing work to any technician, or before appointing Cable Jointers or Wiremen on Site, Contractor has to submit such Technicians’ / Wireman’s / Cable Jointer’s licence to Owner. All wires and cables shall be embossed with the manufacturer’s label with ISI mark and shall be brought to site in original packing. For all internal wiring, PVC insulated wires of 1100 volts grade (FRLS) shall be used.

The sub-circuit wiring for point shall be carried out in loop system and no joints shall be allowed in the length of the
conductors. No wire shall be drawn into any conduit until all defective work of conduit installation of any nature that may cause injury to wire is completed. Care shall be taken while pulling out the wires so that no damage occurs to conduits/wire itself, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction. The minimum size of PVC insulated copper conductor wires for all sub-circuit wiring for light points shall be minimum 2.5 sq.mm copper. Separate neutral to be pulled for each circuit.

1.13 Joints
All joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switches boxes only. No joints shall be made in conduits and in junction boxes. Conductors shall be continuous from outlet to inlet.

1.14 Mains and Sub-Mains
Mains and sub-mains cable or wires where called for shall be of the rated capacity and approved make. Every main and sub main wires shall be drawn into an independent adequate size of conduit. Earthing shall be in conformity with relevant IS codes and calculations shall be submitted for verification. An independent earth wire of the proper rating shall be provided for every single phase sub-main. For every 3-phase sub-main, 2 Nos. earth wires of proper rating shall be provided along with the sub-main. The earth wires shall be drawn along with circuit wires through conduit. Where mains and sub-mains cables are connected to switchgear, sufficient extra lengths of cable shall be provided to facilitate easy connections and maintenance. Where necessary, powder-coated 1.6 mm thick sheet steel covering (also called trunking) shall be provided to cover the group of conduits and cables entering and exiting the Wall mounted/Floor mounted SubDBs, DBs, and FDBs, so that the Installation looks neat. The colour of such sheet steel covering (trunking) shall be matching with the colour of the SDBs, DBs and FDBs.

1.15 Load Balancing
Balancing of circuits in three phase installation shall be as planned by the Consultants in the tender drawings and shall be checked by the contractor before the commencement of wiring and shall be strictly adhered to.

1.16 Colour Code of Conductors
Colour code shall be maintained as indicated by the Consultant for the entire wiring installations. Red, yellow, blue shall be for three phases, black for neutral and green with yellow band shall be for earthing.

2 SWITCHES, RECEPTACLES (MODULAR), LIGHTING FIXTURES & LIGHTING CONTROL EQUIPMENT

2.1 Switches
All switches shall be enclosed type flush mounted suitable for 240 volts AC. All switches shall be fixed inside the switch boxes on adjustable flat M S strips/plates with tapped holes and brass machine screws, leaving ample space at the back and sides for accommodating wires. Switch controlling the light point shall be connected to the phase wire of the circuit and load on each switch shall be restricted to maximum 800 watts & maximum 1500 watts per circuit. All wiring accessories shall be BIS approved. Perfect alignment shall be maintained while fixing of the back boxes.

2.2 Socket Outlet
Socket outlets shall be of the three pin. The switch controlling the socket outlet shall be on the phase wire of the circuit and not more than two socket outlets of 16 amps shall be connected on one circuit. An earth wire shall be provided along with the circuit wires and shall be connected to earthing screw inside the box. All sockets shall be shuttered type.
a. Every socket outlet shall be controlled by an individual switch unless mentioned otherwise.

b. The switch controlling the socket outlet shall be on the ‘Live’ side of the line.

c. 6 amps and 16 amps socket outlet shall normally be fixed at any convenient height above the floor level as desired by the Architect. The switch for 6 and 16 amps, socket outlet shall be kept alongwith the socket outlet. However, in special case, if desired by the Architect the 6 amp. socket outlet can be placed at the normal switch level.

In a room containing a fixed bath or shower, there shall be no socket outlet and there shall be no provision for connecting a portable appliance. Any stationary appliance connected permanently in the bath room shall be controlled by an isolator switch or circuit breaker having outlets at such location where water / moisture does not effect. Generally, switches and outlets shall be planned at a minimum distance of 1.5 Metre away from any water supply outlet, so that splashed water may not affect the live installation.

d. Where socket outlets are placed at lower level, they shall be enclosed in a suitable metallic box with the system of wiring adopted or shutter type sockets shall be provided as specified.

e. In an earthed system of supply, a socket outlet and plug shall be of three pin type, the third terminal shall be connected to earth.

f. Conductors connecting electrical appliance with socket outlet shall be flexible twin cord with an earthing cord which shall be secured by connecting between the earth terminal of plug and the metallic body of the electrical appliance.

g. Where use of shutter type of interlocking type of socket is required for any special installation, the items should be separately and specifically listed in the Schedule of Quantities of that particular work.

2.3 Lighting Fixtures & Accessories

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer’s instructions and to the satisfaction of the Project Manager.

2.3.1 Scope :

Scope of work under this section shall include inspection at suppliers/manufacturer’s premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc as required.

2.3.2 Standards :

The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following:

General and safety requirements for Luminaires:

- Part-1 Tubular fluorescent lamps: IS – 1913 (Part-1)
- Industrial lighting fittings with metal reflectors: IS - 1777
- Decorative lighting outfits: IS - 5077
2.3.3 Light Fittings-General Requirements:

a). Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead fitting shall be provided with IP-54 protection.

b) Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/ballasts.
c). All fittings shall be supplied complete with lamps. All mercury vapour and sodium vapour lamp fittings shall be complete with accessories like ballasts, power factor improvement capacitors, starters, etc. Outdoor type fittings shall be provided with weather proof junction boxes (IP-55) and IP-54 Control gear boxes. All fluorescent and CFL fittings shall be provided with electronic ballast as per schedule of quantities.

d) Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires upto 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.

e) All hardwares used in the fitting shall be suitably plated or anodized and passivated.

f) Earthing: Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.

g) Painting/Finish: All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.

h) The housing shall be powder coated/stove-enamelled or anodised as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia mandrel.

i) Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

j) All Light Fitting in Dining Area, Kitchen Area shall be Suspendended type as per the drawings & site requirement.

2.3.4. Light Fittings – Special Requirements

Lighting Fixtures & Accessories
The light fixtures and fittings shall be pre-assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer’s instructions and to the satisfaction of the Project Manager.

2.3.1 Scope:
Scope of work under this section shall include inspection at suppliers/manufacturer’s premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc as required.

2.3.2 Standards:
The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following:
2.3.3 Light Fittings-General Requirements:

a). Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring.

b) Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of ballasts.

c). All fittings shall be supplied complete in all respect

d) Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires upto 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.

e) All hardwares used in the fitting shall be suitably plated or anodized and passivated.

f) Earthing : Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.

g) Painting/Finish : All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.

h) The housing shall be powder coated or anodised as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking

i) Metal used in body of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

2.3.4. LED Light Fittings – Special Requirements

Mechanical specifications

LED luminaries of Single piece Die Cast Aluminium alloy Housing having high conductivity acting as heat sink, with Powder coating with distortion free, clear, Heat Resistant Toughened UV stabilized Glass in the front which shall
be fixed to the housing
Suitable rust-proof screws for fixing of the heat resistant toughened glass / hanging arrangement. The luminaries assembly and manufacturing process for the LED source assembly in modules/arrays shall be designed to assure all internal components are adequately supported to withstand sudden impacts and mechanical shock and vibration from any sources.

2.3.5 Inbuilt protections:
   a) Over Voltage Protection
   b) Transients (Surge Voltage & Current)

2.3.6 Compliance to the following standards:
   i. EN 60598 (General Requirements & Tests)
   ii. Transient voltages, Voltage dips and fluctuations’ shall conform to EN61547 or equivalent.
   iii. EN 61000-3-3 (Flicker)
   iv. EN 55015 (RFI < 30 MHz)

2.4 Lighting Control Equipment

2.4.1 General
The lighting control system shall be centralized or decentralized based on a project requirement. Every device should be microprocessor based, addressable entity.

PIR Occupancy Sensor
The PIR Occupancy Sensor shall detect passive infrared energy for control of any number of independent electrical loads. The light level shall be adjustable from the front of the unit and shall be used to disable the Occupancy Sensor. Timer settings shall be adjustable from 1 second to 18 hours, in one-second increments. A weatherproof version shall be available for outdoor or industrial use.

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information.

The Supply Voltage to each PIR Sensor shall be 36VDC @ 18mA. No additional 240V supply shall be required for the unit to operate.

The unit shall have suitable operating temperatures between 0-50 Degree C.

The unit shall be suitable for wall or ceiling mounting, up to mounting heights of 2.4m.

The Indoor unit shall have a field of view of 90 degrees. The outdoor unit shall have a field of view of 110 degrees.

The Indoor unit shall have an effective detection area of 6m x 6m. The outdoor unit shall have an effective detection area of 18m radius x 110 degrees.

The Indoor unit shall have 12 overlapping detection zones. The outdoor unit shall have 18 long range, 16 intermediate range, 10 short range and 4 ultra short-range detection zones.

Ultrasonic Occupancy Sensor
The unit shall be an active device utilizing Doppler wave technology as its means of detection. The unit shall
include two air transducers to provide volumetric occupancy detection.

The unit shall be suitable for occupancy detection of larger areas, typically 12m x 12m and 2.7m mounting height. The unit shall include its own independent 240V power supply and shall require a socket outlet adjacent to installation point (typically in the lighting wiring loom). To enable the unit to communicate with the control system network, an Auxiliary Switch Input Unit shall be utilized. Each auxiliary unit will allow control of up to four detectors.

The unit will have easily accessible sensitivity adjustment that can be used to accommodate various room sizes.

The unit will have an indicator LED for walk-testing the unit.

The unit shall be ceiling mounted and a 360-degree field of view.

The unit shall utilize an ultrasonic frequency of 32.7 kHz.

The unit shall have suitable operating temperatures between 0-50 Degree C.

**Combined Technology Ultrasonic/PIR Occupancy Sensor**

The unit shall consist of two air transducers and four PIR detectors with a special lens to provide both volumetric and line of sight detection.

The unit shall be suitable for occupancy detection of larger areas, typically 15m x 15m and 2.7m mounting height. The unit shall include its own independent 240V power supply and shall require a socket outlet adjacent to installation point (typically in the lighting wiring loom). To enable the unit to communicate with the control system network, an Auxiliary Switch Input Unit shall be utilized. Each auxiliary unit will allow control of up to four detectors.

The unit shall be ceiling mounted and a 360-degree field of view.

The unit will have easily accessible sensitivity adjustment that can be used to accommodate various room sizes.

The unit will employ programmable walk-testing LED indicators: Red LED for Passive Infrared and Green LED for Ultrasonic modes.

The unit shall utilize an ultrasonic frequency of 32.7 kHz.

The unit shall have suitable operating temperatures between 0-50 Degree C.

**Ultrasonic Occupancy Sensor for Corridors and Hallways**

The unit shall be suitable for occupancy detection of Corridors and Hallways, typically up to 4.6m x 30m and 2.7m mounting height. The unit shall include its own independent 240V power supply and shall require a socket outlet adjacent to installation point (typically in the lighting wiring loom). To enable the unit to communicate with the control system network, an Auxiliary Switch Input Unit shall be utilized. Each auxiliary unit will allow control of up to four detectors.

The unit shall be ceiling mounted and a 360 degree field of view.

The unit will have an indicator LED for walk-testing the unit.
The unit shall utilize an ultrasonic frequency of 32.7 kHz.

The unit shall have suitable operating temperatures between 0-50 Degree C.

2.5 Lighting Control Equipment Product Specifications (Option-II)

2.5.1 Lighting control modules for On/Off switching shall be:
DIN rail mounted consisting of two (2), four (4) or eight (8) or (12) individually programmable integral relays (contactors). The relay shall guarantee a life of >100000 switch operations as per IEC 60947. Relay modules requiring external 220V supply in addition to bus connection shall not be acceptable.

The output states of each of these relays shall be displayed on the front via true mechanical indication. LED status indicators shall not be acceptable. Each of these relays shall be latch-on type with manual operation (override) possible even without power to the system & without having to remove the cover of the control module.

In the event of power failure or bus wiring failure or control module failure, each of the relays shall attain a pre-programmed fail-safe position (‘On’, ‘off’ or ‘as it is Last status’) at the time of commissioning.

The actuators shall be with integrated current detection feature. This functionality shall allow for the monitoring of the load current, and operating hours for load management. It shall be possible to set threshold values of the current in order to detect any lamp failures for facilities management.

The control modules shall be capable of being programmed with different applications to suit site requirements for e.g. staircase lighting function that switches ‘Off’ the relays after a preprogrammed time from the time it has switched ‘On’. The application for which a relay has been programmed shall apply irrespective of the signal from which it is controlled.

Each of the relays shall be capable of being programmed with its own ‘On’ and ‘Off’ delays that shall be applicable irrespective of the signal from which the relays are controlled.

The control modules shall receive its operating power supply from the same bus cable without any other power supply. It should not operate on any 220/240 V AC supply to avoid possible fire hazards. Relay modules with additional power supply to feed other devices in the network shall not be acceptable.

There shall be DIN rail mounted Dimmer modules to allow for dimming of the related lighting loads. The Dimmer modules shall be selected in accordance with the type of light fittings to allow dimming of all type of light.

3. medium voltage 1.1 kv grade xlpe / pvc cables

3.1 General
The MV cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, Specifications, relevant Standard Specifications and cable manufacturer's instruction.

3.2 Material
The MV cables shall be cross linked polyethylene (XLPE)/ PVC core insulated, extruded PVC inner sheathed and extruded HR PVC / FRLS PVC outer sheath of 1100 volts grade as asked for in the schedule of quantities. Cables
shall be of copper and or aluminium conductor as mentioned BOQ.

3.3 Technical Requirements:

3.3.1 All XLPE Aluminium/Copper Power cables shall be 1100 Volts grade, multi core constructed as per IS : 7098 Part-I of 1988 as follows:

a) Stranded Aluminium /Copper conductor as specified in BOQ.

b) Cores laid up

c) The inner sheath should be bonded over with thermo-plastic material for protection against mechanical and electrical damage.

d) Armoring should be provided over the inner sheath to guard against mechanical damage. Armouring should be Galvanised steel wires or galvanised steel strips. (In single core cables used in A.C. system armouring should be non-magnetic hard aluminium Wires/Strips. Round steel wires should be used where diameter over the inner sheath does not exceed 13 mm; above 13 mm flat steel armour should be used. Round wire of different sizes should be provided against specific request.)

e) The outer sheath should be specially formulated heat resistant black PVC compound conforming to the requirement of type ST2 of IS : 5831-1984 extruded to form the outer sheath.

3.3.2 Conductor shall be of electrolytic Aluminium/Copper conforming to IS : 8130 and are compact circular or compact shaped.

3.3.3 Insulation shall be of XLPE type as per latest IS general purpose insulation for maximum rated conductor temperature 70 degree centigrade.

3.3.4 In Inner sheath laid up cores shall be bonded over with thermoplastic material for protection against mechanical and electrical damage. Inner sheath shall be extruded type only.

3.3.5 Insulation, inner sheath and outer sheath shall be applied by extrusion process only.

3.3.6 Armouring shall be of galvanised steel wire/flat.

3.3.7 Repaired cables shall not be used.

3.3.8 Current ratings of the cables shall be as per IS : 3961.

3.3.9 The XLPE insulated cables shall conform to latest revision of IS and shall be read along with these specifications. The Conductor shall be stranded Aluminium/Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.

3.3.10 The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.
3.3.11 Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.

3.3.12 Cables shall be supplied in non-returnable wooden drums as per IS: 10418.

Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.

3.3.13 The product should be coded as per IS: 7098 Part-I as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium Conductor</td>
<td>A</td>
</tr>
<tr>
<td>XLPE Insulation</td>
<td>2X</td>
</tr>
<tr>
<td>Steel round wire armour</td>
<td>W</td>
</tr>
<tr>
<td>Steel strip armour</td>
<td>F</td>
</tr>
<tr>
<td>Steel Double round wire armour</td>
<td>WW</td>
</tr>
<tr>
<td>Steel Double strip armour</td>
<td>FF</td>
</tr>
<tr>
<td>Non-magnetic (Al.) round wire armour</td>
<td>Wa</td>
</tr>
<tr>
<td>Non-magnetic (Al.) strip armour</td>
<td>Fa</td>
</tr>
<tr>
<td>PVC outer sheath</td>
<td>Y</td>
</tr>
</tbody>
</table>

3.4 Inspection
All cables shall be inspected by the contractor upon receipt at site and checked for any damage during transit.

3.5 Joints in Cables
The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoid cable jointing. This apportioning shall be got approved by the Owner's site representative before the cables are cut to lengths. Where joints are unavoidable heat shrinkable type joints shall be made. The location of such joints shall be got approved from the Owner's site representative and shall be identified through a marker.

3.6 Jointing Boxes for Cables
Cable joint boxes shall be installed with heat shrinkable sleeve and of appropriate size, suitable for XLPE armoured cables of particular voltage rating.

3.7 Jointing of Cables
All cable joints shall be made in suitable, approved cable joint boxes and the filling in of compound shall be done in accordance with manufacturers' instructions and in an approved manner. All straight through joints shall be done in epoxy mould boxes with epoxy resin.

All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commence. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

3.8 Cable End Terminations
Cable end termination shall be done in cable terminal box using crimping sockets and proper size of glands of double compression type.
3.9 Bonding of Cables
Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armour clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable conductors.

3.10 Cable Installation
Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks.

3.10.1 Laying of Cables on Cable Trays
The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius as recommended by the manufacturer’s. All cables shall be laid with minimum one diameter gap and shall be clamped at every metre to the cable tray. Cables shall be tagged for identification with aluminum tag and clamped properly at every 20M. Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings. All cable shall be identified by embossing on the tag the size of the cable, place of origin and termination.

All cables passing through holes in floor or walls shall be sealed with fire retardant Sealant and shall be painted with fire retardant paint upto one meter on all joints, terminations and both sides of the wall crossings by “VIPER CABLE RETARD”.

3.10.2 Laying of Cables in Ground
The width of trench for laying single cable shall be minimum 350 mm. Where more than one cable is to be laid in horizontal formation, the width of the trench shall be workout by providing 200 mm gap between the cables, except where otherwise specified. There shall be clearance of 150 mm between the end cable and the side wall of the trench. The minimum depth of the cable trench shall not be less than 750 mm for single layer of cables. When the cables are laid in more than one tier the depth of the trench shall be increased by 300 mm for each additional tier.

Excavation of trenches: The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench. The bottom of the trench shall be levelled and shall be made free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 100 mm in depth. Prior to laying of cables, the cores shall be tested for continuity and insulation resistance. The cable drum shall be properly mounted on jacks, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum and the spindle is horizontal. Cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire drum length shall be laid in one stretch. However, where this is not possible the remainder of the cable shall be removed by ‘Flaking’ i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted off the rollers beginning from one end by helpers standing about 10 meters apart and laid in a reasonably straight line. Cable laid in trenches in a single tier formation shall have a cover of clean, dry sand of not less than 150 mm. above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 300 mm...
shall be provided over the initial bed before the second tier is laid. Finally the cables shall be protected by second class bricks before back filling the trench. The buried depth of uppermost layer of cable shall not be less than 750mm.

**Back Filling**: The trenches shall be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 300 mm. Unless otherwise specified, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

3.11 Cables inside Building

Cables inside buildings shall be laid on the cable trays. All cables passing through walls shall run through GI Pipes sleeves of adequate diameter 50 mm apart maintaining the relative position over the entire length.

3.12 Route Marker

Route marker shall be provided along straight runs of the cables not exceeding 30 meters also for change in the direction of the cable route and underground joints.

Route marker shall be of cast iron painted with aluminum paint. The size of marker shall be 100 mm dia with “Cable” and voltage grade inscribed on it.

3.13 Cable Trays

Ladder and perforated type Cable Trays shall be of Hot dip Galvanized bolted type and factory fabricated out of CRCA sheet with standard accessories like tee, bends, couplers etc. for different loads and number and size of cables as given below:

Cable trays shall be galvanized as per Specification given under 3.14.

a. 1500 mm wide
   Runners 25 x 100 x 25 x 3 mm
   Rungs 2# 20 x 40 x 20 x 3 mm 250 mm C/C
   Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C with base support of 40x 40 x 5mm GI angle.

b. 1200 mm wide
   Runners 25 x 100 x 25 x 3 mm
   Rungs 2# 20 x 40 x 20 x 3 mm 250 mm C/C
   Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C with base support of 40x 40 x 5mm GI angle.

c. 1000 mm wide
   Runners 25 x 100 x 25 x 3 mm
   Rungs 2# 20 x 40 x 20 x 3 mm 250 mm C/C
   Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C with base support of 40x 40 x 5mm GI angle.

d. 750 mm wide
   Runners 20 x 75 x 20 x 2.5 mm
   Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
   Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1800 mm C/C with base support of 40x 40 x 5mm GI angle.

e. 600 mm wide
f. **450 mm wide**
   Runners 20 x 75 x 20 x 2.5 mm
   Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
   Suspenders 2 Nos. 25 x 25 x 4 mm GI angle 1800 mm C/C with base support of 40 x 40 x 5mm GI angle.

Note: Suitable length of 10 mm dia GI rod suspenders at 1800 mm interval shall be included in the item for perforated type cable tray.

**3.14 Specification for Hot Dip Galvanizing Process**
(for Mild Steel Used For Earthing, Cable Trays Or Junction Boxes For Electrical Installation.)

**General Requirements**

I. **Quality of Zinc**

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS:209-1992.

II. **Coating Requirement**

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing.

**3.15 Fire retardant Cable Paint & Fire Barrier**

The fire retardant paint / barrier shall be listed by independent test agencies such as UL, FM or OPL and be tested to, and pass the criteria of ASTM E 814 (UL1479) standard test method for fire test through- penetration fire stops and ASTM E 1996 (UL 2079) standard test method for fire resistive joint system/
3.15.1 Fire retardant cable Paint
The fire resistant cable coating / painting shall be intumescent / ablative, water based compound. The coating shall expand up to 10 times, supplied in a manufacturer seal container indicating manufacturing and expiry dates. The coating material shall be non-toxic, asbestos free, & halogen free and shall have good mechanical strength. The colour of paint shall be white and density of coating shall be 1.3kg/ltr, coating shall have a snap time of 30 minutes, the expansion shall begin at 230 deg.C and it shall have a oxygen index of 41%.

Coating shall be applied by ordinary paint brush after cleaning the cables of dust and oil deposition. A minimum textured finish of 3 mm wet film thickness shall be achieved by applying the material in 2-3 layers leaving intervals of 2 to 8 hours depending upon the moisture and thickness, moisture and temperature hours between each coat.

3.15.2 Fire Barrier sheet for floor and wall sealing
The framing & fixing part of fire barrier sheet shall be very simple & directly fixed around walls & floors by help of anchored bolts & washer. For 2 hour fire rating the fire barrier sheet shall be minimum 7.62 mm thick and shall be cut as per the profile of penetration and opening. The small gap left around the penetration shall be closed with fire rated soft & mouldable putty. Fire barrier must be design on the intumescent technology to seal larger penetration through the fire rated walls & floors. Fire barrier must be a composite construction with the quality incorporated with organic/ inorganic fire resistive elastomeric sheet with specific gravity of 1.6 gm/ cubic centimeter.

3.16 Testing of Cables
Cables shall be tested at works for all routine tests as per IS including the following tests before being dispatched to site by the project team.

a) Insulation Resistance Test.

b) Continuity resistance test.

c) Earth test.(in armoured cables)

d) Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner’s site representative.

a) Insulation Resistance Test( Sectional and overall)

b) Continuity resistance test.

c) Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Owner’s site representative, results will be noted and signed by all present and record be maintained.

4(A) DISTRIBUTION PANELS/BOARDS
Main Distribution Panels, Sub-Distribution Panels and Final Distribution shall be covered under this section. Panels/Boards shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, 4 wire system with neutral grounded at transformer. All Distribution panels shall be CPRI tested design and manufactured by a approved manufacturer. CPRI certificate shall be made available.

Distribution panels shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations.
and shall be as per IS-13947-1993.

4.1 Construction Features

Distribution panels shall be 2 mm thick sheet steel cabinet for indoor installation, dead front, floor mounting/wall mounting type and shall be form 3b construction. The Distribution panels shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors and folded covers, Neoprene gasket, padlocking arrangement and bolted back. All removable/ hinged doors and covers shall be grounded by flexible standard connectors. Distribution panel shall be suitable for the climatic conditions as specified in Special Conditions. Steel sheets used in the construction of Distribution panels shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of Distribution panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum operating clearance of 275 mm shall be provided between the floor of Distribution panels and the lowest operating height.

Distribution panels shall be of adequate size with a provision of spare switchgear as indicated on the Single Line Diagram. Feeders shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the Distribution panels in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.

Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram engraved on PVC sheet. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

4.2 Bus Bar Connections

Bus bar and interconnections shall be of high conductivity electrolytic grade tinned copper as indicated in the bill of quantities complying with requirement of IS : 5082 – 1981 and of rectangular cross section suitable for carrying the rated full load current and short circuit current and shall be extendable on either side. Bus bars and interconnections shall be insulated with heat shrinkable sleeve of 1.1 KV grade and shall be colour coded. Bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bars shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area to be added to the bus bar to compensate for the holes. All connections between bus bars and breakers shall be through solid Tinned copper strips of proper size to carry full rated current and insulated with insulating sleeves. Maximum current density for the busbars shall be 0.8 A/sq.mm for aluminium and 1.4 A/sq.mm for copper busbars. Maximum allowable temperature for the Bus bar to be restricted to 85 deg C

4.2.1 Temperature - Rise Limit

Unless otherwise specified, in the case of external surface of enclosures of bus bar compartment which shall be accessible but do not need to be touched during normal operation, maximum temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces.
All main distribution panels and sub distribution panels shall be provided with MCCB of appropriate capacity as per Single Line Diagram. All final Distribution boards shall be provided with Miniature Circuit Breakers. Final Single Phase Distribution boards shall be connected to the incoming supply through double pole MCB units & earth leakage circuit breakers. All wiring for final distribution boards shall be concealed behind 5 mm thick bakelite sheet or M S sheet cover. All Distribution boards shall be completely factory wired, ready for connection. All the terminals shall be of proper current rating and sized to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Continuous earth bus sized for prospective fault current shall be provided with arrangement for connecting to station earth at two points. Hinged doors/ frames shall be connected to earth through adequately sized flexible braids.

4.3 Cable Compartments
Cable compartment of adequate size shall be provided in the Distribution panels for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables.

4.4 Moulded Case Circuit Breaker (MCCB)
The MCCB should be current limiting type with trip time of less than 10 msec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ. MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2/ IEC 60947-2 and should have test certificates for Breaking capacities from independent test authorities CPRI / ERDA or any accredited international lab.

MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses.

The breaking capacity of MCCB shall be as specified in the schedule of quantities. The rated service breaking capacity (Ics) should be equal to rated ultimate breaking capacities (Icu). MCCBs for motor application should be selected in line with Type-2 Co-ordination as per IEC-60947-2, 1989/IS 13947-2. The breaker as supplied with ROM should meet IP54 degree of protection.

4.4.1 Current Limiting & Coordination
- **The MCCB shall employ maintenance free minimum let-through energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB.** The manufacturer shall provide both the discrimination tables and let-through energy curves for all.

Protection Functions

- MCCBs with Thermal-magnetic shall have adjustable thermal for overload and fixed magnetic for short-circuit protection.
- Microprocessor MCCBs shall be equipped with microprocessor based trip units having complete LSIG protections.
- Microprocessor and thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorised access to the settings.
4.4.2 Testing
a) Original test certificate of the MCCB as per IEC 60947-1 & 2 or IS13947 shall be furnished.
b) Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.

4.4.3 Interlocking
Moulded, case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switch board.
a) Handle interlock to prevent unnecessary manipulations of the breaker.
b) Door interlock to prevent the door being opened when the breaker is in ON position.
c) Defeat-interlocking device to open the door even if the breaker is in ON position.

- The MCCB shall be current limiting type and comprise of quick make – Break switching mechanism. MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable over load & short circuit pick-up both in Thermal magnetic and Microprocessor Trip Units.
- All MCCB with microprocessor based release unit shall have LSI protection. Also wherever specified in BOQ ground fault protection shall be integral part of the microprocessor based release and neutral CT shall be provided incase of Triple pole breaker. Adjustable Overload, Short circuit and earth fault protection with time delay shall be provided.
- The trip command shall override all other commands.

4.5 Motor Protection Circuit Breaker (MPCB)
Motor circuit breakers shall conform to the general recommendations of standard IEC 947 -1,2 and 4 (VDE 660, 0113 NF EN 60 947-1-2-4, BS 4752) and to standards UL 508 and CSA C22-2 N°14.

The devices shall be in utilization category A, conforming to IEC 947-2 and AC3 conforming to IEC 947-4. MPCB shall have a rated operational and insulation voltage of 690V AC (50 Hz) and MPCB shall be suitable for isolation conforming to satandard IEC 60947-2 and shall have a rated impulse withstand voltage (Uimp) of 6 kV. The motor circuit breakers shall be designed to be mounted vertically or horizontally without derating. Power supply shall be from the top or from the bottom. In order to ensure maximum safety, the contacts shall be isolated from other functions such as the operating mechanism, casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the motor circuit breakers must have snap action opening and closing with free tripping of the control devices. All the poles shall close, open, and trip simultaneously. The motor circuit breakers shall accept a padlocking device in the “isolated” position.

The motor circuit breakers shall be equipped with a “PUSH TO TRIP” device on the front enabling the correct operation of the mechanism and poles opening to be checked. The auxiliary contacts shall be front or side
mounting, and both arrangements shall be possible. The front-mounting attachments shall not change the breaker surface area. Depending on its mounting direction the single pole contact block could be NO or NC. All the electrical auxiliaries and accessories shall be equipped with terminal blocks and shall be plug-in type. The motor circuit breakers shall have a combination with the downstream contactor enabling the provision of a perfectly co-ordinated motor-starter. This combination shall enable type 1 or type 2 co-ordination of the protective devices conforming to IEC 60947-4-1. Type 2 co-ordination shall be guaranteed by tables tested and certified by an official laboratory: LOVAG (or other official laboratory). The motor circuit breakers, depending on the type, could be equipped with a door-mounted operator which shall allow the device setting. The motor circuit breakers shall be equipped with releases comprising a thermal element assuring overload protection and a magnetic element for short-circuit protection. In order to ensure safety and avoid unwanted tripping, the magnetic trip threshold (fixed) shall be factory set to an average value of 12 Ir.

All the elements of the motor circuit breakers shall be designated to enable operation at an ambient temperature of 60°C without derating. The thermal trips shall be adjustable on the front by a rotary selector. The adjustment of the protection shall be simultaneous for all poles. Phase unbalance and phase loss detection shall be available. Temperature compensation (-20°C to +60°C)

4.6 Miniature Circuit Breaker (MCB)

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

**Coordination Study in LV Network**

LV Switchgear Manufacturer shall submit coordinated & Discriminated solution for LV Network protection devices i.e. ACB, MCCB, MPCB & MCB for all Incoming and outgoing devices for all Panels/DB’s as per BOQ with the help of published discrimination tables. Total discrimination shall be provided up to the short circuit breaking capacity of most down stream circuit Breakers.

4.7 Residual Current Circuit Breaker Current Operated Type (RCCB)

I. System of Operation

Residual Current Circuit Breaker shall confirm to IEC 61008. RCCB shall work on the principle of core balance transformer. The incoming shall pass through the toroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds a predetermined critical value. RCCB shall be current operated independent of the line voltage, current sensitivity shall be of 30 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.
II. **Mechanical Operation**

The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing / opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

III. **Neutral Advance Feature**

The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact First before the phases; and at the time of opening, the neutral shall break last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

IV. **Testing Provision**

A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB / RCCB and the operating handle shall move to the "OFF" position.

4.8 **Earthing**

Earthing shall be provided as per IS: 3043-1987.

4.9 **Painting**

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be as per BOQ confirming to IS Code No.5.

4.10 **Labels**

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

4.11 **Meters**

i. All voltmeters and indicating lamps shall be through MCB's.

ii. Meters and indicating instruments shall be flush type.

iii. All CT's connection for meters shall be through Test Terminal Block (TTB).

iv. CT ratio and burdens shall be as specified on the Single line diagram.

4.12 **Current Transformers**

Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast/ Flame Retardent resin filled Nylon type robust to withstand thermal and dynamic stresses during short circuits. Metering CTs, shall have inbuilt busbar mounting arrangement. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The secondary terminal should be covered with insulation cap/cover so that there should not be any possibility of touching the live terminal. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class 1.

4.13 **Potential Free Contacts**

Potential free contacts shall be provided for connection to Building Automation System in panels indicated in
Schedule of Quantities.

4.14 Indicating Panel
All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB/MPCB as per relevant fault level and toggle switch.

4(B) FINAL DISTRIBUTION BOARDS (FDB’s)
Final Distribution Boards (FDBs) shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, neutral grounded at transformer. The DB shall be minimum di-electric strength of 2.5 KV / Sec. All Distribution Boards shall manufactured by a manufacturer listed in Appendix-I.

FDB’s shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1993.

4.1 Construction Features
FDB’s shall be made out of 1.6 mm thick (for residential project FDB shall be of minimum 1.2 mm thick) high quality CRCA sheet steel and shall be pre-treated and powder coated sheet steel used in the construction of FDB shall be folded and braced as necessary to provide a rigid support for all component. FDB shall be suitable for indoor / outdoor installation, wall mounting free standing type, in double door construction. The Final Distribution Boards shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket, padlocking arrangement. All removable/ hinged doors and covers shall be grounded by 4.0 sqm tinned stranded copper connectors. Final Distribution Boards shall be suitable for the climatic conditions. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of FDBs.

Knockout holes of appropriate size and number shall be provided in the FDB’s in conformity with the location of cable/conduit connections. Detachable sheet steel gland plates shall be provided at the top / bottom to make holes for additional cable entry at site if required.

Final Distribution Boards shall comprises of the following:

4.1.1.1 A panel for mounting where appropriate incoming supply circuit breaker & other auxiliaries for Control & distribution as required.

4.1.1.2 Installation accessories shall be part of the DB for fixing conductor and rails for mounting MCB’s and RCCB’s etc., neutral bus bars & earthing bus bars required in the circuit. All busbars in the FDB shall be insulated type.

4.1.1.3 Service cable /enterconnection shall be part of the Distribution Boards.

4.1.1.4 The board shall be installed at a height such that the operating is within reach of the normal human height i.e. 1.2 to 1.8 meters from finish floor level.
4.1.1.5 Degree of protection shall be IP-42 for indoor application, IP-65 for kitchen & laundry and IP-65 for outdoor application.

4.1.1.6 All three phase distribution boards shall have 4 rows and single phase distribution boards shall have single rows for housing of MCB's and RCCB's unless noted otherwise.

4.1.1.7 Phase segregation to be maintained in all three phase distribution boards.

4.1.1.8 Earthing shall be provided in each FDB's.

4.1.2 Miniature Circuit Breaker (MCB)
For specifications refer Section 4A, clause 4.7

4.1.3 Residual Current Circuit Breaker Current Operated Type (RCCB)
For specifications refer Section 4A, clause 4.8

4.1.4 Earthing
Earthing shall be provided as per IS:3043-1987.

4.1.5 Painting
All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be of Siemens gray paint shade no. RAL-7032 of IS Code No.5.

4.1.6 Labels
Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

4.1.7 Testing
Testing of panels shall be as per following codes:
I. IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.
II. IS: 13947 : 1993 Degree of protection

4.1.8 Wiring
In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per Consultants drawing.

5. EARTHING
5.1 Earthing
The system shall be TNS with four wire supply system (R,Y,B,N and 2 Nos. E) brought from the main L T Panel. All the non-current carrying metal parts of electrical installation and all metal conduits trunking, cable sheaths, switchgear, distribution panels, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All metal work such as pipe lines, ducts, cable trays, stair case railing etc shall be bonded to earth.
All earthing shall be in conformity with IS:3043 1987, and the basic system of earthing shall be TNS.

5.2 Earthing Conductors
Earthing conductors shall be of copper / GI as mentioned in schedule of quantities and shall be protected against mechanical injury and corrosion.

5.3 Sizing of Earthing Conductors
The cross sectional area of earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80 Sq.mm. If the area of the largest current carrying conductor or bus bar exceeds 160 sq.mm then two or more earthing conductors shall be used in parallel, to provide at least half the cross sectional area of the current carrying conductor or bus bars. All fixtures, outlet boxes, junction boxes and power circuits up to 15 amps shall be earthed with PVC insulated copper wire.

5.4 Connection of Earthing Conductors
Main earthing conductors shall be taken from the earth connections at the main L T panel to an earth electrode with which the connection is to be made. All joints in tapes shall be with four rivets and shall be brazed in case of copper and by welding bolting in case of GI, wires shall be connected with crimping lugs, all bolts shall have spring washers. Sub-mains earthing conductors shall run from the main distribution panel to the sub distribution panel. Final distribution panel earthing conductors shall run from sub-distribution panel.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed. The installation shall be complete in all respects for efficient and trouble free service. All work shall be carried out in a first class quality and neat workmanship. Grounding conductors shall be handled carefully to avoid kinking and cutting of the conductors during their installation. All exposed ground conductors run shall be taken in a neat manner horizontal, vertical and parallel to the building walls or columns and shall not be laid haphazardly. All connections to the grounding grid shall be made with earthing strip welded to grid and bolted at equipment ends.

5.5 Prohibited Connections
Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system. The electrical resistance measured between earth connection at the main L T panel and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate or circuit breakers, and shall not exceed 1 ohm. All switches carrying medium voltage shall be connected with earth by two separate and distinct connections. The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size. The overlapping in strips at joints where required shall be minimum 75 mm. The joints shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner. Sweated lugs of adequate capacity and size shall be used for termination of all conductor wires above 6 sq.mm size. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned. Equipotential bonding of all metallic structures
shall be done.

5.6 Earthing
The following must always be ensured in earthing system.
- All earths must be interconnected at the earth pits. This includes generator neutrals, transformer neutrals, transformer body, lightning protection system earths, UPS earths etc.
- Extraneous conductive parts such as gas pipes, other service pipes and ducting risers and pipes of fire protection equipment and exposed metallic parts of the building structure.

5.7 The Contractor shall get the soil resistivity test done at his own cost of the area where earthing pits are to be located before starting the installation.

5.8 Resistance to Earth
The resistance of earthing system shall not exceed 1 ohm.

5.9 Specification for Hot Dip Galvanizing Process
General Requirements
I. Quality of Zinc
Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS:209-1992.

II. Coating Requirement
Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing. Jointing of earthing tape shall be by welding. All joints and cut ends shall be properly painted with aluminium paint.

(Note : Please specify only one type as per project requirement)

5.10 Earthing Electrode

Conventional Plate electrode

Copper Earth Electrode
Earthing electrode shall be 600 x 600 x 3.15 mm thick tined copper plate electrode, with 2 Nos 50 x 6 mm copper strips from earth plate electrode to inspection chamber, 50 mm dia medium class GI pipe, CI funnel with 20 gauge GI wire mesh, masonry chamber 1000 x 500 mm with concrete base as per IS3043 with C I heavy duty / chequered plate manhole cover with frame painted with bitumastic paint and packing with mixture of charcoal and common salt around plate electrode including digging of pit upto permanent moisture level and as per soil condition but not less than 3 meters and back filling as required.
GI Earth Electrode
Earthing electrode shall be 600 x 600 x 6.3 mm thick GI plate electrode, with 2 nos. 50 X 6 mm GI strips from earth plate electrode to inspection chamber, 50 mm dia medium class GI pipe, CI funnel with 20 gauge GI wire mesh, masonry chamber 1000 X 500 mm with concrete base as per IS3043 with CI manhole cover with frame painted with bitumastic paint and packing with mixture of charcoal and common salt around plate electrode including digging of pit upto permanent moisture level but not less than 3 meters and back filling as required.

6. LIGHTNING PROTECTION SYSTEM (EARLY STREAMER EMISSION TYPE BASED ON FRENCH STANDARD NFC 17-102)

6.1 Scope of Work
The work to be done under this section comprises the supply & installation necessary for the complete installation of the lightning protection system.

The design of the components shall be traceable to field research, laboratory testing, fundamental analysis, and statistical levels of the lightning event.

The design of the components shall be traceable to long term practical field studies laboratory testing, fundamental scientific principles and statistical levels of the lightning event as documented in international standard.

The lightning protection system shall comply in accordance with NFC 17-102 standard and shall be installed strictly to the manufacturer’s instructions.

The advanced lightning protection system shall include components as follows:
- ESE Air terminal
- Mechanical supports
- Down-conductors
- Performance Recording Equipment
- A low impedance Grounding system.

6.2 Standards
Complete installation shall be engineering and constructed in accordance with the latest revision of the following:
- NFC-17-102
- IEC 61204

The details of the lightning protection system shall also confirm to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this specification and drawings, whichever is more stringent and acceptable to the engineer.

6.3 Air Terminal
The air termination shall be of the type that responds dynamically to the appearance of a lightning down leader by creating free electrons between outer surfaces and an earthed central finial rod.

The Air terminal shall work under Early Streamer Emission (ESE) Technology and the attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics.
The Lightning conductor shall deliver a unique gain time in efficiency, anticipating the natural formation of an upward leader. The Air terminal generates a leader that propagates rapidly to capture the Lightning stroke and conduct it towards the ground.

Arcing is not to be continuous and shall only occur during the progress of the lightning leader.

The air termination shall not cause high frequency radio interference except during the millisecond intervals associated with the progress of the lightning leader and during the main return strike of lightning events in the region.

The materials of the air termination shall be non-corroding in normal atmosphere.

The air termination shall not be dependent upon batteries or external power supplies for any part of its operation.

The Height of the air terminal support mast shall be minimum 2mts and the height will be increased as per the coverage design.

The support shall be securely installed and guy wires shall be used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

6.4 Down Conductor
In order to reduce probability of damage it is often necessary to have several parallel current paths. As recommended by IEC 62305 & IS 2309 equal spacing of down conductors, 25 x 3 mm Copper \ AL \ GI external strip, is preferred around the building perimeter or 1C x copper conductor special cable offered by LA supplier (recommended when laid in shaft within building). Two down conductors shall be used in case of the structure height is above 28mts and both shall be connected with maintenance-free Grounding system down conductor shall be connected directly to the air termination.

The down conductor shall be installed in accordance with the manufacturer’s instructions and shall not be subject to sharper bends.

The down conductor must be kept in constant physical contact with the structure via conductive mounting clamps.

Each down conductor shall be directly connected at the dedicated earthing pit and the dedicated earth pit shall be connected to the other earth pits in the earthing grid.

6.5 Lightning Flash Counter
Each protection system shall be supplied with Lightning strike counter. The counter shall have a register that activates one count for every discharge where the peak current exceeds 400A at the 8/20us standard.

The lightning flash counter shall be robust and easy to install. The counter shall operate from the energy of the lightning discharge and shall not work on external or battery power to operate.

The lightning flash counter shall be installed to the manufacturer’s instructions in a readily accessible manner (always 2mts above the Ground) so that reading can be taken at regular intervals. It shall be positioned such that its operating temperature is within the range -20°C to + 60°C.

6.6 Grounding System
The Lightning arrestor grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the specifying engineer or manufacturer of the lightning protection system.

Grounding will be done by copper bonded steel core ground rods especially designed for electrical grounding.

Bonding of the grounding system to metallic parts of the building, the structural reinforcing steel of the building to arriving services is recommended.

Electrically conductive, non soluble TEREC Powder shall be used to achieve low ground resistance. Provided the materials are mixed and installed strictly in accordance with the manufacturer's instructions.

6.7 Lightning and Surge Voltage Protection

6.7.1 Scope
This specification describes the electrical and mechanical requirements for a high energy Transient Voltage Surge Suppressor (TVSS). The specified TVSS/SPD system shall be connected in parallel to the facility's electrical main incoming (main LT panel) as well as final distribution boards, shall provide effective high energy surge current diversion, and shall be suitable for application in ANSI/IEEE C62.41 Category A, B and C environments or IEC 61643-1 Class I, II and III

6.7.2 Codes & Standards
The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:

IEC 61643-1: Surge Protective Devices connected to low voltage power distribution systems.

6.7.3 Electrical Requirements
A. Nominal system operating voltage
The single phase TVSS system shall be suitable for installations operating between 220VAC and 240VAC.
The three phase TVSS system shall be suitable for installations operating between 380VAC to 415VAC, Star (Y) Configuration: 3 Phase 4 Wire Plus Ground or Delta Configuration: 3 phase 4 wire including Ground.

B. Maximum Continuous Operating Voltage (MCOV):
The maximum continuous operating voltage of the complete TVSS, as well as all components in the suppression path shall be greater than 125% of the nominal system operating voltage to ensure the ability of the system to withstand temporary RMS over voltages (swell conditions).

C. Operation Frequency:
The operating frequency range of the system shall be 50 or 60 Hz.

D. Protection Modes:
Note: L = Line, G = Ground, N = Neutral

The SPD shall provide protection in all modes (L-N or L-L, L-G and N-G where applicable)

E. Surge Current Capacity:

<table>
<thead>
<tr>
<th>Location</th>
<th>Class</th>
<th>Surge Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Service Entrance</td>
<td>Class C</td>
<td>200/400 KA</td>
</tr>
<tr>
<td>Main Distribution Feeders</td>
<td>Class B</td>
<td>100/160 KA</td>
</tr>
<tr>
<td>Sub distribution Panels</td>
<td>Class A</td>
<td>50 KA</td>
</tr>
</tbody>
</table>

F. Short-circuit Withstand Capability:

The TVSS shall be able to carry the power short circuit current until it is interrupted by external over-current disconnect or by the backup over current protection. The minimum Short Circuit Withstand of the TVSS shall be according to the table below:

<table>
<thead>
<tr>
<th>Class</th>
<th>Minimum Short Circuit Withstand Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class C</td>
<td>200KA</td>
</tr>
<tr>
<td>Class B</td>
<td>35 to 65KA</td>
</tr>
<tr>
<td>Class A</td>
<td>14KA</td>
</tr>
</tbody>
</table>

G. Over current Protection (fusing)

All components, including suppression, filtering, and monitoring components, shall be individually fused at the component level with the fuses rated so as not to impede maximum specified surge current capacity. The fuse shall be capable of opening in less than one millisecond and clear both high and low impedance faults.

H. Clamping Voltage:

The TVSS shall able to clamp the voltage:

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Max Let Through Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>120, 120/208 or 120/240</td>
<td>400 volts</td>
</tr>
<tr>
<td>208, 240, 277, 230/400 or 277/480</td>
<td>800 volts</td>
</tr>
<tr>
<td>346, or 346/600</td>
<td>1200 volts</td>
</tr>
<tr>
<td>480</td>
<td>1500 volts</td>
</tr>
<tr>
<td>600</td>
<td>2000 volts</td>
</tr>
</tbody>
</table>
I. Response Time:
The typical response time of all suppression components shall be <0.5 ns.

J. Noise Attenuation
The filter shall provide insertion loss with a maximum of 40dB to 50dB from 10 kHz to 100 MHz with data obtained utilizing the 50 ohm Insertion Loss Methodology from MIL-STD-220A.

6.7.4 Environmental Requirements
A. Operating Temperature: -40 to +85 C (-40 to +187 F)
B. Relative humidity: 0% to 95%
C. Audible Noise: The unit shall not generate any appreciable noise. 40 DB for RFI and EMI noise attenuation
D. Operating Altitude: 0 to 14,000 feet above sea level.
E. Magnetic Fields: The unit shall not generate any appreciable magnetic fields, and shall suitable for use directly inside computer rooms.
F. Connection type: Parallel
G. Protection lvl in kV – based on level of protection
H. Status indication – LED type dry contacts

7. CABLING FOR DATA SYSTEM

7.1 Scope
This document defines the cabling system and subsystem components to include cable, termination hardware, supporting hardware, and miscellany required to supply, and to install a complete cabling infrastructure supporting data and video. The intent of this section is to provide pertinent information to allow the vendor to bid the labor, supervision, tooling, materials, and miscellaneous mounting hardware and consumables to install a complete system. However, it is the responsibility of the vendor to propose any, and, all items required for a complete system whether or not it is identified in the specification, drawings and bill of materials attached to this specification.

7.2 Applicable Documents
The cabling system described in this specification is derived in part from the recommendations made in industry standard documents. The list of documents below (or the latest revisions) has bearing on the desired cabling infrastructure are incorporated into this specification by reference:
1) This Technical Specification and Associated Drawings
2) ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard – March 2001
5) ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial
7.3 Cabling System and Component Specifications

7.3.1 UTP Cabling System

7.3.1.1 Unshielded twisted pair cabling system, TIA / EIA 568-B.1 addendum Category 6 Cabling system

<table>
<thead>
<tr>
<th>Networks Supported</th>
<th>10 / 100 Ethernet, 155 Mbps ATM, 1000 Mbps IEEE 802.3ab Ethernet, and proposed Cat 6 Gigabit Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warranty</td>
<td>25-year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs</td>
</tr>
<tr>
<td>Performance characteristics</td>
<td>Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel</td>
</tr>
</tbody>
</table>

7.3.1.2 Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2

<table>
<thead>
<tr>
<th>Material:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductors</td>
<td>23 AWG solid bare copper or better</td>
</tr>
<tr>
<td>Insulation</td>
<td>Polyethylene</td>
</tr>
<tr>
<td>Jacket</td>
<td>Flame Retardant PVC</td>
</tr>
<tr>
<td>Pair Separator</td>
<td>Cross-member fluted Spline.</td>
</tr>
<tr>
<td>Approvals</td>
<td>UL Listed</td>
</tr>
<tr>
<td>ETL verified to TIA / EIA</td>
<td>Cat 6</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-20 Deg. C to +60 Deg. C</td>
</tr>
<tr>
<td>Frequency tested up to</td>
<td>Minimum 600 MHz</td>
</tr>
<tr>
<td>Packing</td>
<td>Box of 305 meters</td>
</tr>
<tr>
<td>Delay Skew</td>
<td>45ns MAX.</td>
</tr>
<tr>
<td>Impedance</td>
<td>100 Ohms + / - 15 ohms, 1 to 600 MHz.</td>
</tr>
<tr>
<td>Performance characteristics</td>
<td>Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR</td>
</tr>
</tbody>
</table>

7.3.2 UTP Jacks

<table>
<thead>
<tr>
<th>Type</th>
<th>PCB based, Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durability</td>
<td></td>
</tr>
<tr>
<td>Modular Jack</td>
<td>750 mating cycles</td>
</tr>
<tr>
<td>Wire terminal</td>
<td>200 termination cycles</td>
</tr>
<tr>
<td>Accessories</td>
<td>Strain relief and bend-limiting boot for cable</td>
</tr>
<tr>
<td></td>
<td>Integrated hinged dust cover</td>
</tr>
<tr>
<td>Housing</td>
<td>Polyphenylene oxide, 94V-0 rated</td>
</tr>
<tr>
<td>Wiring blocks</td>
<td>Polycarbonate, 94V-0 rated</td>
</tr>
<tr>
<td>Jack contacts</td>
<td>Phosphorous bronze, plated with 1.27 micro-meter thick gold</td>
</tr>
<tr>
<td>Approvals</td>
<td>UL listed</td>
</tr>
<tr>
<td>Performance</td>
<td>Attenuation, NEXT, PS NEXT, FEXT and Return Loss</td>
</tr>
</tbody>
</table>
7.3.3 **UTP Jack Panels**

**Type**: 24-port, PCB based, Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2

- **Ports**: 24
- **Port arrangement**: Modules of 6-ports each, arranged 1port x 6.
- **Category**: Category 6
- **Circuit Identification Scheme**: Icons on each of 24-ports
- **Port Identification**: 9mm or 12mm Labels on each of 24-ports (to be included in supply)
- **Height**: 1 U (1.75 inches)
- **Durability**: Modular Jack 750 mating cycles, Wire terminal (110 block) 200 termination cycles
- **Accessories**: Strain relief and bend limiting boot for cable
- **Materials**:
  - **Housing**: Polyphenylene oxide, 94V-0 rated
  - **Wiring blocks**: Polycarbonate, 94V-0 rated
  - **Jack contacts**: Phosphorous bronze, plated with 1.27micro-meter thick gold
  - **Panel**: Black, powder coated steel
  - **Approvals**: UL listed
  - **Termination Pattern**: TIA / EIA 568 A and B
- **Performance**:
  - **Characteristics to be provided along with bid**: Attenuation, NEXT, PS NEXT, FEXT and Return Loss

7.3.4 **Faceplates**

**Type**: 1-port, White surface box

- **Material**: ABS / UL 94 V-0
- **No. of ports**: One

7.3.5 **Workstation / Equipment Cords**

**Type**: Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2

- **Conductor**: 24 AWG 7 / 32, stranded copper
- **Length**: 7-feet
- **Plug Protection**: Matching colored snag-less, elastomer polyolefin boot
- **Warranty**: 25-year component warranty
- **Category**: Category 5
- **Plug Housing**: Clear polycarbonate
- **Terminals**: Phosphor Bronze, 50 micron gold plating over selected area and gold flash over remainder, over 100 micron nickel underplate
- **Load bar**: PBT polyester
- **Jacket**: PVC
7.3.6 **Fiber optic Cable**

- **Cable Type**: 6-core, Multimode, 10G Ethernet OM3, Armored, loose-tube, Gel Filled
- **Fiber type**: 50 / 125, Laser Grade, 250 micron primary coated buffers
- **No. of cores**: 6
- **Cable Construction**: BELLCORE GR 20 / IEC 794-1
- **Attenuation**
  - @850nm: 3.5 dB / KM
  - @1300nm: 1.5 dB / KM
- **Bandwidth**
  - @850nm: 1500 MHz-KM
  - @1300nm: 500 MHz-KM
- **Network Support**
  - 10 / 100 Ethernet: 2000m
  - 155 Mbps ATM: 2000m
  - 1000 Base SX: 900m
  - 1000 Base Lx: 550m without Mode Conditioning launch patch cord.
- **Tensile rating**: 1200N
- **Maximum Crush resistance**: 3000N
- **Operating Temperature**: -40 Degree C to +60 Degree C
- **Armor**: Corrugated Steel tape Armor

**Note**: For Composite fiber optic cables, the above specifications for SM and MM fibers apply.

7.3.7 **Fiber Optic Connectors**

- **Connector Type**: SC-Style, Simplex
- **Operating temperature**: -40 Degree C to +85 Degree C
- **Durability & color**
  - MM connectors: 500 cycles, Beige
  - SM connectors: 220 cycles, Blue
- **Ferrules**: Pre-radiused Ceramic Ferrules
- **Attenuation**: Not more than 0.75 dB per mated pair

7.3.8 **Fiber Optic Patch panels**

- **Fiber optic patch panel**: 19-inch, Rack mounted Fiber optic patch panel
- **Height**: 3 U, 5.25 inches
- **# of fibers**: 48,96,192
- **# of OSP Cables for termination**: Minimum 2
- **Grounding**: 2 Nos. of earthing lugs, pre-loaded
- **Cable Management rings**: Front and rear cable management rings, pre-loaded
# of 6-port / 12-port adapter plates 8 / 8 Max.

Fiber optic patch panel
- Height: 1 U, 1.75 inches
- # of fibers: 18, 36, 72
- # of OSP Cables for termination: Minimum 2
- Grounding: 2 Nos. of earthing lugs, pre-loaded
- Cable Management: Front and rear cable management rings, pre-loaded
- # of 6-port / 12-port adapter plates: 3 / 3 Max.

7.3.9 Fiber Optic Adapter plates
- Fiber Optic adapter plate: 6-port, SC-Style, MM
- Attenuation: Max of 0.75 dB per mated pair

7.3.10 Fiber Optic Patch Cord
- Fiber Optic Patch Cords: 50/125 Ethernet Patch Cord
- Bandwidth:
  - @650nm: 500 MHz-KM
  - @1300nm: 500 MHz-KM
- Insertion Loss: Less than 0.5 dB

7.4 Warranty
Owner seeks warranty for the installed cable plant from the OEM equipment supplier. Bidder shall ensure that the OEM norms for supply, installation, testing and documentation as specified by the OEM supplier shall be adhered to, provided those are in line with TIA / EIA standards and Owner requirement specifications. The warranty shall be provided by the OEM vendor to Owner and shall be administered in India. The duration of the warranty shall be for a minimum of 25 years and shall cover the system performance, application assurance and the costs of the supply of components and installation.

SECTION 'C'- PLUMBING WORK

1.0 GENERAL INSTRUCTIONS

1.1 GENERAL INSTRUCTIONS: The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein, and shall be guidance for proper execution of work to the required standards. It may also be noted that the specifications are of generalised nature and these shall be read in conjunction with the description of item in schedule of quantities and drawings. The work also includes all minor details of construction which are obviously and fairly intended and which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.
Unless specifically otherwise mentioned, all the applicable codes and standards published by the Indian Standard Institution and all other standards which may be published by them before the date of receipt of tenders, shall govern in all respects of design, workmanship, quality and properties of materials and methods of testing, method of measurements etc. Wherever any reference to any Indian Standard Specification occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued therein or revisions thereof, if any, up to the date of receipt of tenders. In case there is no I.S.I. specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, and requirements of the Engineer-in-Charge. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust etc. under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.

Samples of various materials, fittings etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineer-in-charge before order for bulk supply is placed.

The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.

The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased delivery is contemplated, this provision shall apply to each phase.

The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.

The contractor shall clear the site thoroughly of all debris, surplus excavated materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer-in-Charge before the work is considered as complete.

The Chief Engineer, DCSE, DAE, shall be the sole deciding authority as to the meaning, interpretations and implications for various provisions of the specifications and his decision in writing shall be final and binding on all concerned.

In case any difference or discrepancy between the specifications and the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy between specifications and drawing, the specifications shall take precedence. In case any difference or discrepancy between the specifications for Civil works and specification for Public Health Engg. works, specifications for Civil works shall take precedence.

1.1.1. **PRECAUTIONS** While carrying out pipe line work in case the contractor encounter any interference with other services such as cables, conduits etc, he shall take sufficient precautions in order to prevent any damage to them. If any damage occurs, it shall be rectified to its original condition at his own cost to the satisfaction of the officers concerned with such services.

The contractor shall ensure that all inserts, pipe lines embedded in structural members or sleeves are placed in position in co-ordination with civil work.

All public health engineering services shall be handed over to Engineer-in-charge complete in all respects on completion of the work. Incomplete work will not be taken over. Any loss or damage to these services due to any
1.1.2. **COST TO BE COVERED:** The rates quoted by the tenderer under this contract shall cover the cost of all the following elements.

1.1.3. **MISCELLANEOUS WORK:** The contractor carrying out the construction work shall take effective measures to carefully open out all existing channels, culverts, bridges, pipelines, conduits, water courses, sewer, drains, electrical cables, transmission lines and their supports and all works buried or otherwise where such services have to be interfered with the purpose of the construction of the works. He shall provide and arrange all necessary temporary supports and diversions if necessary across/under/even through along sides of the trenches and all other parts of construction works for all such channels, culverts, bridges, pipe lines, conduits.

1.1.4. **CLEARANCE FOR ROADS AND FOOT PATHS:** The contractor shall arrange to carry out all works with least interference practicable with public footpath and vehicular traffic and with existing waste water or storm water drainage arrangements and provide all necessary road barriers, fences, notices, lights, gangways, access crossings, diversions for traffic, temporary drains, dewatering channels, chutes pumping or water lifting arrangements and all other facilities for the proper execution of the works to the approval and satisfaction in all respects of the Engineer-in-Charge. Any work carried out by the contractor in this connection shall be deemed as temporary works incidental to the construction work.

1.1.5. **LOCATION:** The rates quoted by the tenderer under this contract shall be applicable for the work at all floor and locations.

1.1.6. **DEWATERING:** The rates quoted by the tenderer under this contract shall include bailing or pumping out all the water which may accumulate during the progress of the work either through seepage, springs, rain or any other cause.

1.1.7. **WATER SUPPLY MAIN:** The cost includes for transport charges and testing charges prescribed by the municipal Corporation. Water mains thus laid shall be tested to a pressure as specified in the schedule and specifications. Contractor has to get the pipe line laid hydraulically tested by the Municipal Authorities. Contractor has to bear the Municipal hydraulic testing charges.

1.1.8. **FORMALITIES WITH STATUTORY BODIES:** The work shall be carried out in a manner complying in all respects with requirement of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account. The contractor has to satisfy all the requirement of fire brigade, drainage and hydraulic engineering department of Municipal Corporation.

*Note: In case a separate item is included in the schedule of quantities, contractor shall engage a licensed P.H. engineer/ licensed plumber and obtain all the above certificates from Municipal Corporation. The Department shall authorise the contractor to deal with BMC on behalf of the Department.*

1.2. **MINIMUM WEIGHT OF MOST COMMONLY USED SANITARY APPLIANCES & WATER FITTINGS:**

   The minimum unit weight of each fitting shall not be less than as given in the following table and tolerance for weight shall be as per relevant IS code.
The minimum unit weight of each fitting shall not be less than as given in the following table which are used in General practice.

<table>
<thead>
<tr>
<th>Description of items</th>
<th>Nominal size/ thickness</th>
<th>IS code</th>
<th>Minimum Unit Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brass non-fancy type Bib Tap Please see Table under relevant item for other sizes.</td>
<td>15mm</td>
<td>781-1984</td>
<td>400 Grams</td>
</tr>
<tr>
<td>C.P. brass fancy type Bib Tap</td>
<td>15mm</td>
<td>8931-1993</td>
<td>550 Grams</td>
</tr>
<tr>
<td>Brass non-fancy types Stop cock – Internally threaded</td>
<td>15mm</td>
<td>781-1984</td>
<td>330 Grams</td>
</tr>
<tr>
<td>Brass non-fancy types Stop cock – Externally threaded</td>
<td>15mm</td>
<td>781-1984</td>
<td>400 Grams</td>
</tr>
<tr>
<td>C.P. brass fancy types Stop cock</td>
<td>15mm</td>
<td>8931-1993</td>
<td>550 Grams</td>
</tr>
<tr>
<td>C.P. brass concealed typed Stop cock</td>
<td>15mm</td>
<td>8931-1993</td>
<td>750 Grams</td>
</tr>
<tr>
<td>C.P. brass fancy Pillar Tap</td>
<td>15mm</td>
<td>1795-1982</td>
<td>650 Grams</td>
</tr>
<tr>
<td>C.P. brass waste coupling</td>
<td>32mm</td>
<td>3311-1979</td>
<td>200 Grams</td>
</tr>
<tr>
<td>C.P. brass waste coupling</td>
<td>40mm</td>
<td>3311-1979</td>
<td>250 Grams</td>
</tr>
<tr>
<td>C.I. Nahani Trap 165mm inlet dia.</td>
<td>75mm(outlet)</td>
<td>1729-2002/ 3989-1984</td>
<td>6.50 Kg.</td>
</tr>
<tr>
<td>C.I. Floor Trap 100 mm inlet dia.</td>
<td>75mm(outlet)</td>
<td>1729-2002/ 3989-1984</td>
<td>4.80 Kg.</td>
</tr>
<tr>
<td>C.I. Nahani Trap with 20 mm water seal</td>
<td>65mm(outlet)</td>
<td>non ISI</td>
<td>4.50 Kg.</td>
</tr>
<tr>
<td>Cast Iron surface box for sluice valve (rectangular shape)</td>
<td></td>
<td>3950-1979</td>
<td>33 kg.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description of items</th>
<th>Nominal size/ thickness</th>
<th>IS code</th>
<th>Minimum Unit Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.P. brass fancy Shower rose</td>
<td>15mm</td>
<td>125 Grams</td>
<td></td>
</tr>
<tr>
<td>C.P. brass bottle trap</td>
<td>32mm</td>
<td>500 Grams</td>
<td></td>
</tr>
<tr>
<td>C.P. brass bottle trap</td>
<td>40mm</td>
<td>550 Grams</td>
<td></td>
</tr>
<tr>
<td>C.P. brass Liquid soap dispenser</td>
<td></td>
<td>250 Grams</td>
<td></td>
</tr>
<tr>
<td>C.P. brass coat and hat hook</td>
<td></td>
<td>150 Grams</td>
<td></td>
</tr>
<tr>
<td>C.P. brass Towel rod bracket [pair]</td>
<td></td>
<td>100 Grams</td>
<td></td>
</tr>
<tr>
<td>C.P. brass Towel rod [600 mm long]</td>
<td>20mm</td>
<td>150 Grams</td>
<td></td>
</tr>
<tr>
<td>G.I. Clamps thickness for GI piping</td>
<td>2 MM</td>
<td>150 Grams</td>
<td></td>
</tr>
<tr>
<td>MS Clamps thickness for CI piping</td>
<td>3 MM</td>
<td>150 Grams</td>
<td></td>
</tr>
<tr>
<td>Rain water lead sheet flashing</td>
<td></td>
<td>38.00 kg/sqm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Weight</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>C.I. frame and cover for Gully Trap</td>
<td>7.50 kg.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>S.S. grating for Nahani Trap</td>
<td>50 Grams</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>C.P. brass grating for Nahani Trap</td>
<td>190 Grams</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>C.P. Brass Dome shape grating</td>
<td>275 Grams</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Cast Iron surface box for sluice valve (circular shape)</td>
<td>14 kg.</td>
<td></td>
</tr>
</tbody>
</table>
1.3. **MANDATORY TESTS / OPTIONAL TESTS**:

1. The following mandatory tests shall be carried out when the qty. of materials to be incorporated in the work exceeds the minimum qty. specified in col.5 of the table below irrespective of whether the materials are with I.S. mark, or otherwise.

2. Optional tests specified or any other tests shall be carried out in case of specialized work/ important structure at Department's discretion.

3. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for all mandatory tests.

4. Testing charges for optional tests shall be paid by the Dept. However, the incidental charges and cost of sample for testing shall be borne by the contractor.

5. In case of non-I.S. materials, it shall be the responsibility of the contractor to establish the conformity of material with relevant I.S. specification by carrying out necessary tests. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for such tests.

1.3.1. **Mandatory tests for P.H.E. works**

<table>
<thead>
<tr>
<th>Material</th>
<th>Test</th>
<th>Field/lab test</th>
<th>Test Procedure</th>
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1.3.2. Testing, tolerances, Acceptance and mode of payment

a) The materials should pass all tests and tolerance in dimensional, chemical, physical properties should be within the limit as stipulated in relevant I.S. for acceptance. Such materials will be accepted as standard.

b) Payments shall be restricted to standard unit mass, or as specified in the schedule, without making any cost adjustment towards mass or any other properties provided the material pass all the tests and tolerance are within the specified limit.

c) In case of non-standard materials, materials not covered under any I.S specification, such as aluminium sections, the payment shall be made based on the actual unit weight as determined by testing at random sampling.

Post construction Inspection and testing: After completion of work and during the maintenance liability period of contract, the work shall be subjected to “Post construction and testing”. In case, if the materials incorporated in the work are found to be inferior, though the sample collected from the materials might have been passed at the time of execution, it shall be the responsibility of the contractor to replace the same without any cost to the department failing which the department may rectify the same at the risk and cost of the contractor or the department may accept the same as sub standard, and cost be adjusted from the outstanding security deposit as per the terms and condition of the contract for the work.
2.0. GENERAL SPECIFICATIONS:

2.1. EARTH WORK AND BACKFILL

2.1.1. SCOPE OF WORK:
The scope of work covered under this specifications pertains to excavation of foundations, trenches, pits and over areas, in all sorts of soils, soft and hard rock, correct to dimensions given in the drawing including shoring, protections of existing underground utilities if any, such as water lines, electric cables etc., dewatering and shoring if necessary, stacking the useful materials as directed within the lead specified, refilling around the foundation and into the plinth with selected useful excavated earth and disposing off the surplus earth/materials within specified lead and finishing the surface to proper levels, slopes and camber etc. all complete.

2.1.2. SITE CLEARANCE:
Before the earth work is started the area coming under cutting and filling shall be cleared of all obstructions, loose stones, shrubs, rank vegetation, grass, brush-wood, trees and saplings of girth upto 30 cm. measured at a height of one metre above ground and rubbish removed upto a distance of 150 metres outside the periphery of the area under clearance. The roots of trees shall be removed to a minimum depth of 60 cm. below ground level, or a minimum of 30 cm. below formation level whichever is lower, and the hollows filled up with earth, levelled and rammed. This work is deemed to be included in the earth work items and no separate payment will be admissible for the work.

The trees of girth above 30 cm. measured at a height of one meter above ground, shall only be cut after permission of the Engineer-in-charge is obtained in writing. The roots shall also be removed as described in the preceding sub-para. Payment for cutting and removing roots of such trees shall be made separately. Any material obtained from the site will be the property of the Department and the useful materials as decided by the Engineerin-charge will be conveyed and properly stacked as directed within the lead specified.

2.1.3. SETTING OUT AND MAKING PROFILES:
Masonry or concrete pillars will be erected at suitable points in the area to serve as bench marks for the execution of the work. These bench marks shall be connected with G. T. S. or any other permanent bench mark approved by the Engineer-in-charge. Necessary profiles with pegs, bamboos and strings or Burjis shall be made to show the correct formation levels before the work is started. The contractor shall supply labour and materials for setting out and making profiles and Burjis for the work at his own cost and the same shall be maintained during the excavation work. The Department will show grid Co-ordinate or other reference points. It shall be the responsibility of the contractor to set out centre lines correctly with reference to the drawings and install substantial reference marks. Checking of such alignment by the Department will not absolve the contractor from his responsibility to execute the work strictly in accordance with the drawings.

2.1.4. EARTHWORK:
The contractor shall notify the Engineer-in-charge before starting excavation and before the ground is disturbed, to enable him to take existing levels for the purpose of measurements. The ground levels shall be taken at 5 to 15 metres intervals in uniformly sloping ground and at closer distance where local mounts, pits or undulations are met with, as directed by the Engineer-in-charge. The ground levels shall be recorded in field books and plotted on plans, which shall be signed by the Contractor and the Engineer-in-charge, before the earth work is actually started. The labour required for taking levels, shall be supplied by the Contractor at his own cost. The Contractor shall perform excavation in all types of soils, murrum, soft and hard rock, boulders etc. in foundation, over areas and in trenches to widths, lines, levels, grades and curves as shown in the drawing or lesser widths, lines and levels as directed by the Engineer-in-charge and as per items in the schedule of quantities.
2.1.4.1. The item in the schedule of quantities shall specify the excavation in trenches
For this purpose, the excavation in trenches for foundations and for pipes, cables etc. not exceeding 1.5 m. in
width and for chambers, manhole, shafts, wells, cesspits and the like not exceeding 10 sqm. on plan and to
any depth shall be described as Excavation in trenches for foundation, drains, pipes and cables and returning
the excavated material to fill the trenches after pipes, cables etc. are laid and their joints tested and passed
and disposal of surplus excavated material upto 50 m lead.

2.1.4.2. Excavation exceeding 1.5 m. in width as well as 10 sqm. on plan (excluding trenches for pipes, cables etc.)
and exceeding 30 cm in depth shall be described as Excavation over areas.

2.1.5. CLASSIFICATION OF EARTH WORK:
The earth work shall be classified under the following main categories and measured separately for each category.

a. All types of soils, murrum, boulders.
b. Soft rock.
c. Hard rock.

2.1.5.1.

a) ALL TYPES OF SOILS, MURRUM, BOULD: This includes earth, murrum, top deposits of agricultural soil,
reclaimed soil, clay, sand or any combination thereof and soft and hard murrum, shingle etc. which is loose enough
to be removed with spades, shovel and pick axes. Boulders not more than 0.03 cum. in volume found during the
course of excavation shall also fall under this classification.

b) EXCAVATION IN SOFT ROCK : This shall include all materials which are rock or hard conglomerate, all
decomposed weathered rock, highly fissured rock, old masonry, boulders bigger than 0.03 cum. in volume but not
bigger than 0.5 cum. and other varieties of soft rock which can be removed only with pick axes, crow bars, wedges
and hammers with some difficulty. The mere fact that the contractor resorts to blasting and/or wedging and
chiselling for reasons of his own, shall not mean the rock is classifiable as hard rock.

c) EXCAVATION IN HARD ROCK : This includes all rock other than soft rock mentioned in para 2.1.5.1 b viz. soft
rock, occurring in masses, boulders having approximate volume more than 0.5 cum. plain or reinforced cement
concrete, which can best be removed by blasting or chiselling and wedging where blasting cannot be permitted
owing to any restriction at site.

i) EXCAVATION IN HARD ROCK BY BLASTING: Where blasting is permitted the excavation in rock shall be done by
means of blasting. No heavy blasting will be permitted and not only controlled / muffled blasting will be permitted at the
discretion of the Engineer-in-Charge. The Contractor shall be governed by the relevant statutory laws, rules and
regulations on explosives, pertaining to the acquisition, transport, storage, handling and use of explosive which shall be
rigidly followed and shall obtain himself all necessary materials and equipment for blasting. Blasting shall be executed
through a licensed blaster with prior permission from police authorities. Prior to blasting sufficient notice shall be given
to concerned parties to avoid danger to people, materials and nearby structures. All the damages caused by careless
blasting if any shall be made good by the contractor at his own expenses.

ii) EXCAVATION IN HARD ROCK BY CHISELLING AND WEDGING: Where blasting is not permitted and if the
Engineer-in-Charge so desires, the excavation shall be done by chiselling and wedging or any other agreed method.

NOTE: All the excavated hard rock obtained shall be stacked properly and neatly within the specified lead by the
contractor as directed by the Engineer-in-Charge.
2.1.6. **EXCAVATION:** The excavation under all classifications in areas in trenches or in pits shall be carried out systematically. Cutting shall be done from top to bottom and no under-pining or undercutting will be allowed. The bottom and sides of excavation shall be dressed to proper level, slopes, steps, camber etc. by removing high spots, and ramming thoroughly as directed by the Engineer-in-charge.

All the excavation shall be carried out strictly to the dimensions given in the drawing. The width shall generally be of the width of mudmat concrete and depth as shown in drawing or as directed by the Engineer-in-Charge, according to availability of the desired bearing capacity of soil below. Any excavation if taken below the specified depths and levels, the contractor shall at his own cost fill up such overcut to the specified level with cement concrete 1:4:8 in case of excavation in all types of soils and with cement concrete 1:2:4 in case of excavation in soft and hard rock.

After the excavation is completed, the contractor shall notify the Engineer-in-Charge to that effect and no further work shall be taken up until the Engineer-in-Charge has approved the depth and dimensions and also the nature of foundation materials. Levels and measurements shall also be recorded prior to taking up any further work.

2.1.6.1. **SIZES OF TRENCH FOR EXCAVATION FOR PIPE LINE:** Where the width of trench is not specified the following shall apply.

a) Upto 1.0 metre deep shall be arrived at by adding 25 cm to the external diameter of pipe (not socket/collar) cable, conduit etc where a pipe is laid on concrete bed/cushioning layer, the authorised width shall be the external diameter of the pipe (not socket/collar) plus 25 cm or the width of concrete bed/cushioning layer whichever is more.

b) For depths exceeding one metre, an allowance of 5 cm per metre of depth for each side of the trench shall be added to the authorised width (that is external diameter of pipe plus 25 cm) for excavation. This allowance shall apply to the entire depth of the trench. In firm soils upto a depth of 2 metres from the bottom. For depths greater than 2 metres, the excavation profiles shall be widened by allowing steps of 50 cm on either side after every two metres from bottom.

c) Where more than one pipe, cable, conduit etc. are laid, the diameter shall be reckoned as the horizontal distance from outside to outside of the outermost pipes, cable, conduit etc.

d) Where the soil is soft, loose or slushy, width of trench shall be suitably increased or side sloped or the soil shored-up as directed by the Engineer-In-Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-In-Charge regarding increase in the width of trench, sloping or shoring to be done for excavation in soft, loose or slushy soils.

2.1.6.2. **SIZES OF TRENCH FOR EXCAVATION FOR CHAMBERS, MANHOLES, SHAFTS, WELLS, CESSPITS:** Authorised working space shall be special in each case. Where authorised working space is not so specified the following shall apply:

600 mm measured from the external face of substructure/walls (including protective measures like water proof plaster, tile cladding etc. if any) at lowest level, where extra working space is required.

2.1.7. **SHORING:**

Unless separately provided for in the schedule of quantities, the quoted rate for excavation shall include excavation of slopes to prevent falling in soil by providing and/or fixing, maintaining and removing of shoring, bracing etc. The contractor would be responsible for the design of shoring for proper retaining of sides of trenches, pits etc. with due
consideration to the traffic, superimposed loads etc. Shoring shall be of sufficient strength to resist the pressure and ensure safety from slips and to prevent damage to work and property and injury to persons. It shall be removed as directed after items for which it is required are completed. Should the slips occur, the slipped material shall be removed and slope dressed to a modified stable slope. Removal of the slipped earth will not be measured for payment.

2.1.8. DEWATERING:
Unless specifically provided for as a separate item in the schedule of quantities, rate shall also include bailing or pumping out all water which may accumulate in the excavation during the progress of further works such as mud mat concrete, R.C. footings, shuttering etc. either due to seepage, springs, rain or any other cause and diverting surface flow by bunds or other means. Care shall be taken to ensure that the water discharged sufficiently away from the foundations to keep it free from nuisance to other works in the neighbourhood.

2.1.9. DISPOSAL OF EXCAVATED MATERIALS:
   a) ANTQUITIES: Any finds of archaeological interest such as relics of antiquity, coins, fossils or other articles of value shall be delivered to the Engineer-in-Charge and shall be the property of the Government.

   b) USEFUL MATERIALS: Any material obtained from the excavation which in the opinion of the Engineer-in-Charge is useful, shall be stacked separately in regular stacks as directed by the Engineer-in-Charge and shall be the property of the Government.

   No material excavated from foundation trenches of whatever kind they may be are to be placed even temporarily nearer than about 3 m. from the outer edge of excavation. Discretion of the Engineer-in-Charge in such cases is final. All materials excavated will remain the property of the Department. Rate for excavation includes sorting out of the useful materials and stacking them separately as directed within the specific lead.

   Materials suitable and useful for refilling or other use shall be stacked in convenient place but not in such a way as to obstruct free movement of materials, workers and vehicles or encroach on the area required for constructional purposes. It shall be used to the extent required to completely backfill the structure to original ground level or other elevation shown on the plan or as directed by the Engineer-in-Charge. Materials not useful in anyway shall be disposed off, leveled and compacted as directed by the Engineer-in-Charge within a specified lead. The site shall be left clean of all debris and leveled on completion.

2.1.10. REFILLING IN SIDES OF CHAMBERS, DRAINS ETC.:
   The back filling shall be done after the concrete or masonry has fully set and shall be done in such a way as not to cause under-thrust on any part of the structure. Where suitable excavated material is to be used for back filling, it shall be brought from the place where it was temporarily deposited and shall be used in refilling. The scope of work for back filling/filling in sides of chambers and other areas shall include filling for all the excavation covered under the contract. Surplus earth available from the excavation, if required, shall be used for refilling/filling for filling the trenches for pipes cables buildings also within the specified lead mentioned in the item.

   All timber shoring and form work left in the trenches, pits, floors etc. shall be removed after their necessity ceases and trash of any sort shall be cleared out from the excavation. All the space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface with approved materials in layers not exceeding 200 mm. in thickness, watered and well consolidated by means of rammers to atleast 90% of the consolidation obtainable at optimum moisture content (Proctor density). Flooding with water for consolidation will not be allowed. Areas inaccessible to mechanical equipment such as areas adjacent to walls and columns etc. shall be tamped by hand rammer or by hand held power rammers to the required density. The backfill shall be uniform in character and free from large lumps, stones, shingle or boulder not larger than 80 mm. in any direction, salt, clods, organic or other foreign
materials which might rot. The refilling in plinth and under floors shall be done in similar way in layers not exceeding 200 mm. thick and shall be well consolidated by means of mechanical or hand operated rammers as specified to achieve the required density.

Test to establish proper consolidation as required will be carried out by the Department at rates specified. Two tests per 50 sqm. will be taken to ascertain the proper consolidation. The cost of tests carried out will be recovered from the contractors bill.

2.1.11. **REFILLING IN TRENCHES FOR PIPES, CABLES ETC.**

Filling in trenches shall be commenced soon after the joints of pipes, cables, conduits etc. have been tested and passed. The space around the pipes, cables, conduits etc. shall be cleared of all debris, brick bats etc. Where the trenches are excavated in hard/soft soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 20 cm in depth. Each layer shall be watered, rammed and consolidated. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before the excavated earth is used for filling. In case of excavation of trenches in ordinary/hard rock, the filling upto a depth of 30 cm above the crown of pipe, cable, conduits etc. shall be done with fine material like earth, murrum or pulverised/decomposed rock according to the availability at site. The remaining filling shall be done with boulders of size not exceeding 15 cm mixed with fine material like decomposed rock, murrum or earth as available to fill up the voids, watered, rammed and consolidated in layers not exceeding 30 cm. Excavated material containing deleterious material, salt peter earth etc. shall not be used for filling. Ramming shall be done with iron rammers where feasible and with blunt ends of crow bars where rammers cannot be used. Special care shall be taken to ensure that no damage is caused to the pipes, cables, conduits etc. laid in the trenches.

2.1.12. **LEAD & LIFT**

**LEAD:** The lead for disposal/deposition of excavated materials shall be as specified in the respective item of work. For the purpose of measurements of lead, the area to be excavated or filled or area on which excavated material is to be deposited/ disposed off shall be divided in suitable blocks and for each of the block, the distance between centre lines shall be taken as the lead which shall be measured by the shortest straight line route on the plan and not the actual route adopted.

**LIFT:** Lift shall be measured from ground level. Excavation up to 1.5 m depth below ground level and depositing excavated material on the ground shall be included in the item of earthwork for various kinds of soil. Extra lift shall be measured in unit of 1.5 m or part thereof. Obvious lift shall only be measured; that is lifts inherent in the lead due to ground slope shall not be measured except for lead upto 250 m. All excavation shall be measured in successive stages of 1.5 m stating the commencing level. This shall not apply to cases where no lift is involved as in hill side cutting.

2.1.13. **MODE OF MEASUREMENTS:**

2.1.13.1. All excavation in areas having depth more than 30 cm. pits, trenches etc. shall be measured net. The dimensions for the purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, rafts or other foundations, multiplied by the mean depth from the surface of ground determined by levels. Excavation for side slopes will not be paid for. Excavation in areas having depths less than 30 cms. shall be measured as surface excavation on square metre basis, mentioning the average depth of excavation.

Reasonable working space beyond concrete dimension required for waterproofing and shuttering where considered necessary in the opinion of Engineer-in Charge will be allowed in execution and considered for payment for underground water tank, sump, septic tank etc.
2.1.13.2. Wherever direct measurements of rock excavation are not possible, volume of rock be calculated on the basis of length, breadth and depth of stacks made at site. The net volume shall be worked out by reducing it by 50%, taking the voids into consideration as 50%. Similarly to arrive at net quantity to be paid in the case of soil, reduction @ 20% of corresponding stack/truck measurements shall be made.

2.1.13.3. The rate for excavation shall include carting and disposing and levelling the excavated materials within the specified lead. The rate shall also be inclusive of cost of all tools, plants, explosives, shoring, dewatering at various stages, labour, materials etc. to complete all the operations specified.

2.1.13.4. The backfilling and consolidation in sides of foundation and in plinth with excavated material will not be paid for separately. The rate quoted for excavation shall be deemed to have been included the cost of stacking of excavated materials, conveying within the specified lead, picking of selected stacked materials, conveying it to the place of final backfill, compaction to the required proctor density etc.

2.1.13.5. Payment for filling and consolidation inside the trenches, sides of foundations, plinth etc. with selected materials brought by the contractor other than the excavated material, shall be paid for separately as per the rates in schedule of quantities which includes cost of such materials/excavation, royalty, its conveyance within the specified lead, watering, consolidating, dressing etc. Actual quantity of consolidated filling shall be measured and paid in cubic metres upto two places of decimal.

2.1.13.6. The rate quoted in cum. For items of excavation id deemed to include the necessary additional quantity of excavation involved beyond the plan dimensions of the work which may be necessary to be carried out for carrying out the work in an engineering manner, decided upon by the contractor. Therefore no extra payment will be made for any excavation done other than the required quantity as per the plan dimension indicated in the drawings.

2.1.13.7. Measurement for excavation over areas shall be determined by levels or by “Dead men” or both at the discretion of the Engineer-in-Charge. If however the Engineer-in-Charge decides on measurement by levels, levels of site shall be jointly taken and recorded by the Engineer-in-Charge or his representatives and the contractor, before commencement of the work and after completion of the work and the quantity of work shall be computed based on these levels. The volume of earth work shall be computed based on “Simpson’s formula” or any other approved method at the discretion of the Engineer-in-Charge.

2.1.14. MODE OF PAYMENT: The contract rate shall be for unit cubic meter of earth work.

2.2. PLAIN CEMENT CONCRETE:

2.2.1. GENERAL: The specification covers the requirement of ordinary Cement Concrete of the specified proportion to be used for various concrete items.

2.2.2. MATERIAL: The material requirement for particular item shall be as per IS 456

2.2.3. CEMENT: Cement shall be OPC/PPC cement conforming to IS 269 & IS 1489 respectively. Cement shall be stored in dry godowns or sheds use of PPC slag cement as approved by the Engineer In-charge, out of construction with damp ground on a 0.6M height platform. Cement shall not be stored in the open. All cement shall be kept well stacked and no cement other than intended to use in the work, shall be used. The cement shall be stored as received and shall be
consumed in the order in which consignments are received and shall not be stored for long periods. No clogged cement caused by dampness shall be used. Blended cement for finishing work shall be used with the prior approval of the Engineer In-charge.

2.2.4. **FINE AGGREGATE:** The sand shall be clean, well graded, hard, strong, durable and gritty particles of size 0.15 mm to 5 mm free from mica, dust, clay, kankar, soft or flaky particles and other deleterious materials. If the fine aggregate contain more than 4 percent of clay, dust or silt it shall be washed. Sea sand should not be used. The fineness modulus may range between 2.6 to 3.6.

2.2.5. **COARSE AGGREGATE:** All stone aggregate to be used for cement concrete shall be from approved sources. The aggregate shall be clean hard, strong and durable. It shall not contain soft, flaky thin or elongated pieces, alkali organic matter or other notorious matter. The specific gravity of the aggregate shall be between 2.5 to 2.7.

2.2.6. **STORAGE, SCREENING AND WASHING:** It shall be stored at the work site in such a manner as to prevent contamination. All aggregate shall be stored to convenient height on hard and dry platform. The contractor shall install screens, one for coarse aggregate and one for sand and shall thoroughly wash all aggregate if directed by Engineer-in-charge.

2.2.7. **WATER:** The water shall be confirming to IS 3025. The water shall be clean and free from deleterious matters such as acids, oils, alkalies, sugar and vegetable matter. Every attempt shall be made to use water that is fit for drinking and whenever possible, water shall be used direct from the supply mains. PH value of water shall not be less than 6.

2.2.8. **PROPORTIONING OF MIX:** In ordinary concrete although proportion of cement to fine and course aggregate is specified by volume, the quantity of cement shall be determined by weight assuming one bag of cement weighing 50 kg. net to be equivalent to 35 Ltrs. fine and course aggregate shall be measured by dry volume in suitable measuring boxes. The allowance shall be made for bulking in the fine aggregate due to moisture if any at the time of mixing. Water cement ratio will be such as will give concrete just sufficient workable to place and compact with out difficulty.

2.2.9. **MIXING:** In all the cases concrete shall be mixed in a mechanical mixer at the site of work, mixer and other accessories should be in first class condition and well maintained through out the construction. Mixing shall be continued till the homogeneous mixture is obtained but in no case mixing shall be done for less than 1.5. minutes.

When hand mixing is permitted by Engineer-in-charge in any special condition, it shall be done on a smooth, hard and water tight, platform large enough to allow sufficient turning over of the ingredients of concrete after adding the water. The material shall be mixed in dry state and turned over until they are thoroughly and fully mixed homogeneously. In hand mixing, the quantity of cement shall be increased by 10 percent with out any extra cost. Retampering or remixing of partially hardened concrete shall not be permitted.

2.2.10. **PLACING:** The concrete shall be transported in such a manner that there shall be no tendency for the segregation of the different ingredients and it shall not be dropped into position from the height greater than 1.00 meter and shall be placed within 30 minutes after mixing. It shall not be interfered when once it has become to set. When new concrete is to be placed on the already set concrete, the surface of the old concrete shall be thoroughly roughened & wetted before the new concrete is laid. Cement sand slurry (1:2) being laid over the surface of the old concrete which is roughened, washed and wetted. The stripped surface of concrete shall be smooth & sharp. Any honey combing, air holes,board marks etc, shall be finished smooth.

2.2.11. **COMPACTION:** The concrete shall be thoroughly compacted during depositing to get dense concrete. The concrete shall not be disturbed once it is set. For important works, the use of mechanical vibrator is essential. The vibrator shall
not be less than 4000 to 5000 impulse per minute and shall be worked at an interval about 600 mm. Over vibration shall be avoided.

2.2.12. DEWATERING: The item rate shall include bailing or pumping out all water if accumulated during the progress of the work either from seepage, springs, rain or any other cause.

2.2.13. FORM WORK: The forms shall generally comply with IS 456 & IS 14687. The shuttering shall be of wood or metal. Before placing the concrete the inside of the forms which comes into contact with concrete shall be coated with mineral oil. The forms shall be erected in position firmly so that it should not be dislocated during concreting. The forms shall be removed without damaging the concrete structure after development of sufficient strength and taking consent of the Engineer-In-Charge.

2.2.14. DEFECTIVE CONCRETE: The defective concrete surface shall be made good as per the direction of Engineer-In-Charge at the contractor’s own cost and charges.

2.2.15. WATERING AND CURING: All the concrete work shall be kept wet continuously for a period of at least 14 days to prevent excessive evaporation. In hot and dry weather matting or gunny bags may be hung on out side of the concrete surface to keep moist.

2.2.16. THE RATE INCLUDES FOR:
1. Installation and removal of scaffolding and shuttering.
2. Cost includes transporting, placing, compacting, curing and finishing cement concrete,
3. Necessary sampling and tests for materials and concrete.
4. Dewatering the pit or trench if found necessary till completion of work.
5. All labour, materials, use of equipment, tools and plants.

2.2.17. MODE OF MEASUREMENT: The measurement shall be for unit cubic meter of concrete or as specified in schedule of work. The concrete shall be measure for its length, breadth and depth. Deduction for pipe shall be made as per the actual outer dimension of the pipe.

2.2.18. MODE OF PAYMENT: The contract rate shall be for unit cubic meter of concrete or as specified in the schedule of work.

2.3. BRICK MASONARY:

2.3.1. GENERAL: This specification covers requirement of the Brick Work in specified proportion of cement mortar.

2.3.2. BRICK: Brick shall generally confirmed to IS 1077. All the bricks to be used in the work shall be well bunt clay brick of class 35, red colour, homogeneous in texture, free from flaws, cracks and crevices. They shall have a frog of 10 mm. depth on one side of their flat faces. No brick after twenty four hours immersion in water shall absorb more than 25% of its own weight and strength should not be less than 3.5 MPa (35 kg/Sq.cm). The test report of the bricks shall be submitted to the Engineer-in-charge at the contractor’s own cost, if required Brick shall be uniformly burnt throughout but not over burnt, shall give the clear metallic ringing sound when struck.

2.3.3. BRICK WORK: All bricks shall be thoroughly soaked in water before use till the bubbles ceases to come up. No half or quarter brick shall be used except as closures. The course shall be horizontal and the wall shall be raised to plumb. Joints in brick wall shall not exceed to 10mm thick. Brick work shall be uniformly raised around to heights as per drawings. All joints shall thoroughly flushed with mortar at every courses. Care shall be taken to see that the bricks are
properly bedded and joint completely filled to full depth. No bat or cut bricks shall be used in the work unless absolutely required to give proper shape. Brick work shall be built in cement and sand mortar as specified in the schedule or as per drawing. The joints shall be raked for a depth of 10 mm to receive cement plaster.

2.3.4. **DEWATERING:** The item rate shall include bailing or pumping out all water which may accumulate during the progress of the work either from seepage, springs, rain or any other cause.

2.3.5. **WATERING AND CURING:** All the brick work shall be kept damp continuously for a period of 14 days to prevent excessive evaporation in hot and dry weather matting or gunny bags may hung on the out side of brick work & kept moist.

2.3.6. **THE RATE INCLUDES FOR**

1. Erecting, dismantling and removing the scaffolding, and curing brick work for at least 14 days.
2. Dewatering the pit or trench if found necessary till completion of work.
3. Labour

2.3.7. **MODE OF MEASUREMENT:** The measurements shall be for unit cubic meter of brick work or as specified in the schedule of work. The brick wall shall be measured for its length, breadth and depth.

2.3.8. **MODE OF PAYMENT:** The contract rate shall be for unit cubic meter or as specified in the schedule of work.

2.4. **CEMMENT PLASTER:**

2.4.1. **GENERAL:** This specification covers the requirement of the Cement plaster in the specified proportions.

2.4.2. **CEMENT MORTAR:** Cement and sand shall be mixed to the proportions as described in the schedule. Cement and sand shall be first mixed dry on the dry platform after which sufficient clean water shall be added to bring the whole mix into a plastic condition. No mortar which has started to set shall be used nor such mortar remixed with new one. It shall be removed from the work site at once.

2.4.3. **PLASTERING:** In all plaster work, mortar shall be firmly applied and well pressed into the joints on the surface and dubbed and leveled with a flat wooden rule to give required thickness. Long straight edge shall be freely used to ensure a perfectly plane and even surface. All corner must be finished to their true angle or rounded as directed. Cement plaster should be done in square or strips and shall be done from top to downward.

2.4.4. **FLOATING COAT:** The floating coat over the plaster shall be so done whenever specified in the item with neat cement to finish the surface so that cracks, crevices etc. are not developed in the plaster.

2.4.5. **DEWATERING:** The item rate shall include bailing or pumping out all water if accumulated during the progress of the work either from seepage, springs, rain or any other cause.

2.4.6. **WATERING AND CURING:** All the plaster work shall be kept damp continuously for a period of 14 days to prevent excessive evaporation. In hot and dry weather matting or gunny bag may be hung on the the out side of the plaster in the beginning and kept moist.

2.4.7. **THE RATE INCLUDES FOR:**
1. Erecting, dismantling and removing the scaffolding.
2. Preparation of the surface to receive the plaster of specified thickness and number of coats, curing etc.
3. Labour, materials, tools and plants used to complete the work.

2.4.8. **MODE OF MEASUREMENT:** The measurement shall be for unit square meter of cement plaster. The plaster shall be measured for its length, breadth / depth.

2.4.9. **MODE OF PAYMENT:** The contract rate shall be for unit square meter of plaster.

2.5. **CUTTING OF ASPHALT ROAD AND PAVED YARD:**

2.5.1. **GENERAL:** This specification covers the scope of cutting and breaking the asphalt, concrete roads, paths etc. and making good to its original condition.

2.5.2. **MATERIAL:** Wherever cutting is done across public paths, roads etc. the orders of materials excavated shall be preserved in well manner and reinstatement shall be done in the same order and road brought to the original condition. The contractor shall make up for any deficiency in material at his own cost.

2.5.3. **WORKMANSHIP:** The cutting of road and paved yard shall be done as directed by the E-I-C, Ramming the sub-grade for piping work. The soling stones, spreading the metals to required thickness and making water bound with stone dust/murrum as per requirement shall be reinstated to the original condition at his own cost.

2.5.4. **THE RATE INCLUDES FOR:**

1. Cutting asphalt road, water bound macadam and soling and stacking usable material at site.
2. Ramming sub-grade for laying pipe line and making asphalt road in original condition after completion of work.
3. Labour, materials, tools and plants used to complete the work.

2.5.5. **MODE OF MEASUREMENT:** The measurement shall be for unit square meter. The cutting portion shall be measured for its length and breadth.

2.5.6. **MODE OF PAYMENT:** The contract rate shall be for unit square meter.

2.6. **REMOVAL OF FOOT PATH TILES:**

2.6.1. **GENERAL:** This specification covers the scope of removing stone tiles from foot paths and refixing the tiles as good to its original condition.

2.6.2. **MATERIAL:** Wherever cutting is done across public foot paths and roads, the orders of materials removed from foot paths shall be preserved in well manner and reinstatement shall be done in the same order and foot path brought to the original condition. The contractor shall make up for any deficiency in material at his own cost.

2.6.3. **WORKMANSHIP:** The foot path tiles shall be removed in required area required or as directed by the E-I-C. Ramming the sub-grade for laying and fixing the tiles after completion of work to the original condition with 1:3 cement mortar.

2.6.4. **THE RATE INCLUDES FOR:**

1. Removing the stone tiles from foot paths and stacking at site.
2. Ramming sub-grade for refixing the tiles including cement, sand, tiles etc.
3. Labour, materials, tools and plants used to complete the work.

2.6.5. **MODE OF MEASUREMENT:** The contract rate shall be for unit square meter and it shall be measured for its length and breadth.

2.6.6. **MODE OF PAYMENT:** The contract rate shall be for unit square meter.

2.7. **REMOVAL OF KERB STONE:**

2.7.1. **GENERAL:** This specification covers the scope of removing road side kerb stone and refixing the kerb stone as good to its original condition.

2.7.2. **MATERIAL:** Wherever cutting is done across public paths and roads, the order of materials shall be preserved in well manner and reinstatement shall be done in the same order and it shall be brought to the original condition. The contractor shall make up for any deficiency in material at his own cost.

2.7.3. **WORKMANSHIP:** The road side kerb stone shall be removed to the required length or as directed by the E-I C. Ramming the sub-grade for fixing the kerb stone after completion of work in the original condition with 1:3 cement mortar.

2.7.4. **THE RATE INCLUDES FOR:**

1. Removing the kerb stone and stacking at site.
2. Ramming sub-grade for refixing the kerb stone including cement, sand, kerb stone etc.
3. Labour, materials, tools and plants used to complete the work.

2.7.5. **MODE OF MEASUREMENT:** The measurement shall be for unit running meter and it shall be measured for its length.

2.8. **STRUCTURAL STEEL WORK:**

2.8.1. **GENERAL:** This specification covers the requirement of providing, fabrication and erection of Structural steel work including painting.

2.8.2. **MATERIAL:** All the Structural steel shall conform to IS 226 and IS 800. They shall be free from defects and shall have uniform section with smooth finish.

2.8.3. **FABRICATION AND ERECTION:** Cutting, holding, assembly, riveting, bolting, welding, machining, painting, marking and erection shall be carried out in accordance with approved plans and as directed by Engineer-in-charge and shall comply with IS 800.

2.8.4. **DAMAGED MEMBER:** Any material found, damaged or defective shall not be used and contractor has to replace the same at his own cost and charges.

2.8.5. **PAINTING:** Painting shall be conforming to IS 800. One priming coat of Zinc chromate shall be applied immediately after fabrication and two coats of oil paint of approved shade be applied after completion of erection.

2.8.6. **INSPECTION AND TESTING:** These shall be carried out in conformity with IS 800.
2.8.7. THE RATE INCLUDES FOR:
1. Supplying, fabrication, erecting in position at site the structural steel sections.
2. All labour, materials and use of tools and equipment and painting.

2.8.8. MODE OF MEASUREMENT: The measurement shall be for unit weight.

2.8.9. MODE OF PAYMENT: The contract rate shall be for unit weight.

3.0. SANITARY INSTALLATIONS

3.1. INDIAN WATER CLOSET

3.1.1. GENERAL: The item pertains for providing white or colour glazed vitreous chinaware Indian water closet of size and colour as specified in the schedule including fixing.

3.1.2. MATERIAL: Squatting Pan (Orissa Pattern) is of white or colour glazed vitreous China conforming IS 2556 Part III. Pan shall have flushing rim and are inlet of self draining type. It shall have weep hole at the following inlet to the Pan. The flushing inlet shall be in front unless otherwise specified. The inside of the bottom of the pan shall have sufficient slope from the front to the outlet and surface shall be uniform and smooth to enable easy and quick disposal while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have groove at right angle to the axis of the outlet. In all the cases pan shall have be provided with 100 mm Glazed Vitreous China ‘P’ or ‘S’ trap with 50 mm water seal and 40 mm size vent

3.1.3. FIXING: The water closet pan shall be placed in position as shown in the drawing. The IWC shall be supported on brick masonry in CM 1:4 or as directed by the Engineer-in-charge. The pan shall be fixed slightly lower than the floor level. If the pan or trap is damaged during handling of fixing, it shall be replaced by the contractor at his own cost. The pan, trap and C.I. pipe shall be jointed in 1:1 Cement Mortar with hemp yarn caulked. The gap between W.C. and floor shall be finished with white/matching cement as directed.

3.1.4. PROTECTION AND FINAL CLEANING: The IWC shall be covered with husk and sand till all the civil and electrical works are completed and shall be removed and cleaned on completion of civil and electrical works prior to testing and handing over. However the contractor should ensure that the outlet is plugged with gunny bags or similar materials to avoid the pipe getting blocked.

3.1.5. THE RATE INCLUDES FOR:
1. Water Closet pan with SCI trap ‘P’ or ‘S’ type and jointing in 1:1 cement mortar with hemp yarn caulked.
2. Cutting wall / slab / beam etc. and making all the damage goods to original condition after completion of work.
3. Testing the entire system and rectification of defects, if any.
4. All necessary labour, material and use of tools.

3.1.6. MODE OF MEASUREMENT: The measurement shall be for each unit of W.C. Pan fixed.

3.1.7. MODE OF PAYMENT: The contract rate shall be for each unit of W.C. pan fixed.

3.2. EUROPEAN/ ANGLO INDIA WATER CLOSET:
3.2.1. **GENERAL**: The item pertains for providing white or colour glazed vitreous chinaware European or Anglo Indian water closet with seat and cover of size and colour as specified in the schedule including fixing.

3.2.2. **MATERIAL**: European type water closet shall be wash down pattern unless otherwise specified. Water closet shall be vitreous china conforming to IS 2556 (Part-I & II). The closet shall be of one piece construction and shall have minimum two hole of 6.5 mm diameter for fixing closet to floor. Closet shall have an integral flushing rims of self draining type. Each water closet shall have an integral trap with either ‘S’ or ‘P’ outlet with and trap shall be uniform and smooth in order to enable an efficient flush. Plastic seat and cover shall be of black colour or as specified, they shall have conformity to IS2548 Part I&II.

3.2.3. **FIXING**: The water closet pan shall be placed in position as shown in the drawing. If the pan trap is damaged during handling or fixing, it shall be replaced by the contractor at his own cost. The pan, soil pipe shall be jointed in 1:1 Cement Mortar with hemp yarn caulked. The gap between W.C. and floor shall be finished with white/matching cement and sand as directed. Seat and cover shall be fixed to the Pan by two corrosion resistance hinge with 65 mm shank and threaded to within 25 mm from of flange. Seat shall be fixed in level by providing the washers of rubber with non ferrous or stainless steel washer to bolt.

3.2.4. **THE RATE INCLUDES FOR**:

1. European type water closet with an integral ‘P’ or ‘S’ trap, plastic seat cover, etc. jointing in 1:1 cement mortar with hemp yarn caulked.

2. Cutting hole in wall / slab / beam etc. wherever required. and making all damages good to original condition after completion of work

3. Testing the entire system and rectification of defect if any.

4. All necessary labour, material and use of tools.

3.2.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of W.C. fixed.

3.2.6. **MODE OF PAYMENT**: The contract rate shall be for each unit of W.C. fixed.

3.3. **WASH BASIN**

3.3.1. **GENERAL** The item pertains for providing colour or white glazed vitreous chinaware wash basin with or without pedestal of size and colour as specified in the schedule including fixing.

3.3.2. **MATERIAL**: Wash basins shall be of vitreous china conforming to IS : 2556(Part-IV) of flat back or angle back as specified shall be of one piece construction including combined over flow, basin shall be provided with single or double tap holes of size 28 mm square or 30 mm rounded. Each basin shall have circular waste hole or 5 sq.cm slot type over flow. Pedestals for wash basin shall be exactly same glazing that of basin. Pedestal shall be capable of supporting the basin and completely recessed at the back to accommodate supply and waste pipes and fittings. The basin shall be supported on pan of C.I cantilever brackets conforming to IS 775. Use of MS angle or Tee Section as bracket is not permitted.

3.3.3. **FIXING** The wash basin shall be fixed in position as indicated in the drawing. Basin shall be supported on a pair of C.I brackets which is embedded in cement concrete (1:2:4) block 100 x 75 x 150 mm.
Oval shape or round shape wash basins are required to be fixed in RCC platform with stone tapping either fully sunk in stone top or flush with stone topping.

The wall plaster on seat shall be cut to rest over the top edge of the basin so as not to leave any gap for water seepage through between wall plaster & skirting of basin. The gap between basin and wall shall be finished with white matching cement.

3.3.4. THE RATE INCLUDES FOR:
1. Wash Basin with pair of C.I bracket as required.
2. Cutting hole in wall / slab / beam etc. wherever required. and making all damages good to original condition after completion of work.
3. All necessary material, labour and use of tools.

3.3.5. MODE OF MEASUREMENT: The measurement shall be for each unit of wash basin fixed.

3.3.6. MODE OF PAYMENT: The measurement shall be for each unit of wash basin fixed.

3.4. URINAL

3.4.1. GENERAL: The item pertains for providing colour or white glazed vitreous chinaware urinal in single or range (1,2 & 3) and size as specified in the schedule with necessary fittings and appliances including fixing.

3.4.2. MATERIAL:

3.4.2.1. BOWL TYPE (WITH FLUSHING RIM): Urinal basin shall be flat back or corner wall type lipped in front. The vitreous china conforming to IS 2556 (Part VI). Urinal shall have and integral flushing rim and inlet or supply horn for connecting flush pipe. Flushing rim and inlet shall be of the self draining type. At bottom of basin and outlet horn for connecting outlet shall be provided. The inside surface of the urinal shall be uniform and smooth throughout to ensure efficient flushing.

3.4.2.2. BOWL TYPE FLAT BACK WITHOUT FLUSHING RIM: They shall be of vitreous china conforming to IS:2556 (Part-VI) constructed in one piece with providing slot or alternative fixing arrangement at flat back and where the integral flushing rim is not provided, they shall be provided with ridges in side the bowl to divert towards the front line of the urinal.

3.4.2.3. STALL URINALS: The stall urinal and its screen shall be glazed fire clay conforming IS :771 (Part-III, Sec-2). The inside surface of stall and screen shall be regular and smooth throughout to ensure efficient flushing.

3.4.2.4. CP BRASS FLUSH PIPE: The flushing arrangement to urinals for single or in range shall be of CP brass with CP brass spreader of 15 mm dia conforming to IS : 407. The capacity of flush pipe for urinal in a range shall be as follows:

<table>
<thead>
<tr>
<th>Capacity of flush tank</th>
<th>Size of C.P. brass Flush pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>5 litres</td>
</tr>
<tr>
<td>Main</td>
<td>15mm</td>
</tr>
<tr>
<td>Distribution</td>
<td>15 mm</td>
</tr>
</tbody>
</table>
### 3.4.3. **FIXING:**

#### 3.4.3.1. **BOWL TYPE FLAT BACK URINAL WITHOUT FLUSHING RIM (Single or Range):** Urinal shall be fixed in position by using rawl plug, wooden plug, C.P screws etc. It shall be fixed at height of 65 cm from the standing level to the top of the lip of urinal or as directed by the Engineer-in-charge. Each urinal shall be connected with 32 mm size waste pipe which shall discharge into channel or a floor trap.

#### 3.4.3.2. **STALL URINALS:** The lip of the stall urinal shall be flush with the finished floor level. The stall urinal shall be laid over a fine sand cushion on average 25 mm thickness. The gap between wall surface, finished floor level and urinals shall not be more than 3mm and filled with water proofing plastic compound.

#### 3.4.3.3. **CP BRASS FLUSHING ARRANGEMENT:** The flushing arrangement to urinal in single or range shall be of CP brass from 25 mm dia to 15 mm dia and CP brass spreader of 15 mm size to each urinal including the cost of CP brass elbows, tees, coupling, crosses, clamps, clips, union CP brass check nut and screws etc. CP brass

#### 3.4.4. **THE RATE INCLUDES FOR:**

1. Glazed Urinals (single or in range) and CP brass pipe flushing arrangement including the cost of jointing material.
2. Cutting hole wherever required and making all damage good to original condition after completion of work.
3. Testing the entire system and rectification of defects if any.
4. All necessary materials, labour and use of tools.

#### 3.4.5. **MODE OF MEASUREMENT:** The measurement shall be for each unit of urinal set (single or range) fixed.

#### 3.4.6. **MODE OF PAYMENT:** The contract rate shall be for each unit of urinal set (single or range) fixed.
3.5.4. **MODE OF MEASUREMENT**: The measurement shall be for each unit of squatting plate (single or range) fixed.

3.5.5. **MODE OF PAYMENT**: The contract rate shall be for each unit of urinal squatting plate (single or range) fixed.

3.6. **MARBLE PARTITION**

3.6.1. **GENERAL**: The item pertains for providing marble partition of size and colour as specified in the schedule including fixing.

3.6.2. **MATERIAL**: The partition shall be of 20 mm thick marble slab of size as specified in the schedule. It shall be polished on both sides with exposed to proper shape the exposed edges of Marble shall be made smooth corners rounded. Cracked or damaged marble slab shall not be used in the work and shall be replaced if any by the contractor at his own cost and charges +/-3mm tolerance shall be permissible for thickness of slab.

3.6.3. **FIXING**: Partition shall be fixed vertically in position as indicated in the drawing at proper height. 100 mm wide chases shall be cut in the wall and the partition shall be embedded at least 50 mm in the wall using 1:2:4 cement concrete. After fixing the partition slab, the chases cut in the wall shall be made good to original condition.

3.6.4. **THE RATE INCLUDES FOR**
1. Marble partition slab including cost of cement concrete, cement mortar etc.
2. All necessary labour, material and use of tools.

3.6.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of marble partition fixed.

3.6.6. **MODE OF PAYMENT**: The contract rate shall be for each unit of marble partition fixed.

3.7. **DIVISION PLATE / PARTITION PLATE**

3.7.1. **GENERAL**: The item pertains for providing white or colour glazed vitreous chinaware division plate of size and colour as specified in the schedule including fixing.

3.7.2. **MATERIAL**: Division plate shall be white or colour glazed of size as specified in the schedule, and shall conform to IS 2556 PART VI.

3.7.3. **FIXING**: Division plate shall be fixed vertically in position at proper height with expandable anchor fasteners, CP brass screws, wooden plugs etc.

3.7.4. **THE RATE INCLUDES FOR**
1. Glazed division plate including the cost of CP brass screws, wooden plugs, expandable anchor fasteners etc.
2. All necessary labour, material and use of tools.

3.7.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of division plate fixed.

3.7.6. **MODE OF PAYMENT**: The contract rate shall be for each unit of division plate fixed.

3.8. **HALF ROUND CHANNEL**
3.8.1. **GENERAL**: The item pertains for providing colour or white glazed vitreous chinaware half round channel of size and colour as specified in the schedule including laying and fixing.

3.8.2. **MATERIAL**: The half round channel shall be of white or colour glazed vitreous chinaware of size as mentioned in the schedule with or without dead end and shall conform to IS 2556 part VII.

3.8.3. **FIXING**: The channel shall be laid to the correct alignment to required slope. It shall be fixed on 80 mm thick bed of 1:2:4 cement concrete. The channel shall be used in standard length. Pieces are not allow except where it is necessary to make up exact length. The joint and gap shall be finished with white / matching colour cement.

3.8.4. **THE RATE INCLUDES FOR**
   1. Cement concrete, cutting the channel and wastage etc.
   2. Supplying & fixing vitreous china half round channel
   3. All necessary labour, material and used of tools.

3.8.5. **MODE OF MEASUREMENT**: The measurement shall be for unit running meter length of half round channel of specified diameter fixed.

3.8.6. **MODE OF PAYMENT**: The contract rate shall be for unit running meter of half round channel fixed.

3.9. **GLAZED FLOOR TRAP WITH DOME SHAPED GRATING**

3.9.1. **GENERAL**: The item pertains for providing white glazed vitreous chinaware floor trap with dome shaped C.P. Brass grating of size as specified in the schedule including fixing.

3.9.2. **MATERIAL**: The trap shape be of white vitreous chinaware of 100 mm dia. or as specified in the schedule with hinged type dome shaped grating of chromium plated brass or stainless steel as specified.

3.9.3. **FIXING**: The trap shall be laid to the correct alignment and to required slope. The trap shall be fixed on 80 mm thick bed or 1:2:4 cement concrete. The caulking shall be done using 1:1 cement concrete. The caulking shall be done using 1:1 cement mortar and hemp yarn.

3.9.4. **THE RATE INCLUDES FOR**
   1. Floor trap, dome shaped grating, concrete, cement mortar etc.
   2. Caulking with 1:1 cement mortar with hemp yarn.
   3. All necessary labour, material and use of tools.

3.9.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of floor trap fixed.

3.9.6. **MODE OF PAYMENT**: The contract rate shall be for each unit of floor trap fixed.

3.10. **TOILET PAPER ROLL HOLDER**

3.10.1. **GENERAL**: The item includes providing white or colour glazed vitreous chinaware toilet roll holder of size as mentioned in the schedule including fixing.

3.10.2. **MATERIAL**: The toilet paper roll holder shall be of CP brass or vitreous china on specified and of size and design as
approved by the Engineer-in-charge. Toilet paper roll holder shall conform as per IS standard and should have ISI mark.

3.10.3. **FIXING** : Toilet paper roll holder shall be fixed in position by means of C.P brass covers and rawl plug embedded in the wall. Vitreous china toilet paper roll holder shall fixed into the wall with 1:2 cement mortar. The pocket shall be cut in wall for toilet paper roll holder if not left finishing the gap with white/matching cement.

3.10.4. **THE RATE INCLUDES FOR** :

1. Toilet paper roll holder, cement, sand, curing etc.
2. Cutting the pocket if they are not left.
3. All necessary labour, material and use of tools.

3.10.5. **MODE OF MEASUREMENT** : The measurement shall be for each unit of toilet paper roll holder fixed.

3.10.6. **MODE OF PAYMENT** : The contract rate shall be for each unit of toilet paper roll holder fixed.

3.11. **PVC WATER INLET CONNECTION** :

3.11.1. **GENERAL** : The item pertains to providing colour or white PVC water inlet connection for cistern and wash basins.

3.11.2. **MATERIAL** : PVC water inlet connection shall conform to IS specifications and shall be of standard pattern with nylon insulation of minimum 450 mm long with CP brass check nut at both the end and shall be able to withstand the testing pressure of 1 MPa (10 kg/sq.cm.)

3.11.3. **FIXING** : The PVC water inlet connection shall be fixed in position as indicated in the drawing or as directed by the Engineer-in-charge for flushing cistern and wash basins.

3.11.4. **THE RATE INCLUDES FOR** :

1. Supplying and fixing of PVC water inlet connection.
2. All necessary labour, material and use of tools.

3.11.5. **MODE OF MEASUREMENT** : The measurement shall be for each unit of water inlet connection fixed.

3.11.6. **MODE OF PAYMENT** : The contract rate shall be for each unit of PVC water inlet connection fixed.

3.12. **GLAZED FIRE-CLAY/ VITREOUS CHINA SINK**:

3.12.1. **GENERAL** : Item includes providing white or colour glazed -fire clay sink for kitchen or vitreous china sink for lab as specified in the schedule of quantities including fixing.

3.12.2. **MATERIAL** : Laboratory sink shall be of vitreous china confirming to IS 2556 (PART-V) and kitchen sink shall be of glazed fire-clay conforming to IS 771 (Part-II) and shall have combined over flow of the weir type and invert shall be 30 mm below the top edge. These shall be of one piece construction and floor of sink shall gently slope towards the outlet. The outlet of sink should be suitable for waste fitting having flanges 88 mm diameter and waste hole of 65 mm diameter. the waster hole shall be either rebated or beveled having the depth of 10 mm. C.I brackets for supporting sink shall confirm to IS:
3.12.3. **FIXING**: The sink shall be supported on C.I cantilever brackets, embedded in cement concrete 1:2:4 block of size 100 x 75 x 150 mm. Bracket shall be fixed in the position before dado work is done. The height of front edge of sink from floor level shall be 80 cm or as directed by the Engineer-in-charge. The gap between floor/wall and sink shall finish with white cement.

3.12.4. **THE RATE INCLUDES FOR**:  
1. Sink & C.I brackets (Pair) cement, sand etc.  
2. All necessary labour, material and use of tools.

3.12.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of sink fixed.

3.12.6. **MODE OF PAYMENT**: The contract rate shall be for each unit of sink fixed.

3.13. **STAINLESS STEEL SINK**:  

3.13.1. **GENERAL**: Item includes providing the stainless steel sink with or without drain board of size as specified in the schedule including fixing.

3.13.2. **MATERIAL**: The sink shall be manufactured from stainless steel of Salem or equivalent steel conforming to IS: 13983. Stainless steel sink shall be of one piece construction moulded out of 19 SWG (1mm) stainless steel sheet of grade AISI 304 (18/8) with stainless steel choke – stop strainer (waste coupling) checknuts conforming to IS 13983.

3.13.3. **FIXING**: The sink shall be fixed in position as indicated in the drawing. The sink shall be placed over the brackets or on the platform. Gap between sink and platform / wall shall be finished with white / matching cement.

3.13.4. **THE RATE INCLUDES FOR**:  
1. S.S. sink with waste coupling cement sand etc.  
2. All necessary labour, material and use of tools.

3.13.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of s.s. sink fixed.

3.13.6. **MODE OF PAYMENT**: The contract rate shall be for each unit s.s. sink fixed.

3.14. **SINK DRAIN BOARD**:  

3.14.1. **GENERAL**: The item includes providing white or colour glazed / fire clay drain board of size mentioned in the schedule fixing.

3.14.2. **MATERIAL**: The drain board shall be manufactured from stainless steel of Salem or equivalent steel conforming to IS: 13983. Stainless steel sink shall be of one piece construction and its thickness not less than 1 mm.

3.14.3. **FIXING**: The drain board shall be fixed in the position as indicated in the drawing. It shall be place over the brackets or on the platform. Gap between board and platform / wall shall be finished with white / matching cement.

3.14.4. **THE RATE INCLUDES FOR**: 
3.14.5. MODE OF MEASUREMENT: The measurement shall be for each unit of drain board fixed.

3.14.6. MODE OF PAYMENT: The contract rate shall be for each unit of drain board fixed.

3.15. GLASS MIRROR:

3.15.1. GENERAL: The item providing beveled or plain edges mirror with or without frame of size as mentioned in the schedule including fixing.

3.15.2. MATERIAL: The mirror shall be of superior sheet glass with edges rounded off or beveled, size 600 x 450 mm unless specified in the schedule. It shall be free from flaws, specks or bubbles and thickness plated and should not be less than 5.0 mm. The back of mirror shall be uniformly silver plated and should be free from silvering defects. Silvering shall now have a protective uniform covering of red lid paint, where beveled edge mirror are not available. Fancy looking mirrors with PVC beading/border or aluminum beading on stainless steel beading/border based on manufacturer’s specification, provided nothing extra shall be paid on this account. The backing of mirror shall be provided with 6mm thick marine plywood or environmentally friendly material other than asbestos cement sheet.

3.15.3. FIXING: Mirror shall be fixed in position with 6mm thick marine plywood backing. It shall be fixed by means of 4 nos. of CP brass screws & caps over rubber washers and rawl plug or as per the manufacturer’s specification unless specified otherwise the longer side shall be fixed horizontally.

3.15.4. THE RATE INCLUDES FOR:
   1. Glass mirror with plywood backing CP screws and CP caps etc.
   2. All necessary labour material and the use of tools.

3.15.5. MODE OF MEASUREMENT: The measurement shall be for unit square meter or each unit to glass mirror of size as specified in the schedule.

3.15.6. MODE OF PAYMENT: The contract rate shall be for unit square meter or each unit of glass mirror of size as specified in the schedule.

3.16. LIQUID SOAP DISPENSER:

3.16.1. GENERAL: The item includes prdg. CP liquid soap dispenser of shape as mentioned in the schedule including fixing.

3.16.2. MATERIAL: Liquid Soap Dispenser shall be of C.P brass of heavy quality and from list of approved make.

3.16.3. FIXING: The liquid soap dispenser shall be fixed to proper height and level as indicated in drawing with 40 mm long CP brass screws, wooden rawl plug, drilling hole etc. and making good the wall to original condition after fixing.

3.16.4. THE RATE INCLUDES FOR:
   1. Liquid soap dispenser with CP brackets CP screws etc.
   2. All necessary labour, material and the use of tools.
3.17. **BIB TAP, STOP COCK & ANGLE STOP COCKS:**

3.17.1. **GENERAL**: The item pertains to provide chromium plated brass bib tap and stop cock and angle stop cocks, free flanges (if joined to concealed pipe) including fixing.

3.17.2. **MATERIAL**: Bib cock (Bib tap) is drawn off tap with a horizontal inlet and free outlet and a stop cock is a valve with a suitable means of connections for insertion in a pipe line for controlling or stopping the flow. These shall be of size 15 mm size or as specified and shall be of screw down type. The closing device shall work by means of disc carrying a renewable non-metallic washer with shuts against the water pressure on a seating right angles to the axis of the threaded spindle which operates it. The handle shall be crutch, butterfly or fancy design type securely fixed to the spindle. The tap shall open anti clock wise direction.

Brass bib taps and stop cocks and angle stop cocks shall conform to IS 781, they shall be polished bright. The minimum finished weight of different sizes of bib tap weight of 15 mm size bib tap and stop cock shall be as per table given below. They shall be sound and free from taps, blow hole and fitting. Internal & External surface shall be clean, smooth and free from sand and neatly dressed. Taps shall be nickel chromium plated and thickness of coating shall not be less than service grade No.2 of IS 4827 and plating shall be capable of taking high polish which shall not be easily tarnished.

**MINIMUM FINISHED MASS OF BIB TAPS AND STOP VALVES AS PER IS 781:1984 (Reaffirmed 2001)**

<table>
<thead>
<tr>
<th>Mm</th>
<th>bib taps</th>
<th>Stop Valves</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Internally threaded</td>
<td>Externally threaded</td>
</tr>
<tr>
<td>8</td>
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<tr>
<td>50</td>
<td>-</td>
<td>3.700</td>
</tr>
</tbody>
</table>

Every tap complete with its component shall with stand an internally applied hydraulic pressure of 2 MPa (20 kg/sq.cm) maintained for a period of 2 minutes during the period it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof without any extra cost from contractor.

3.17.3. **FIXING**: Bib tap stop cock shall be fixed to the pipe line with C.P. brass or G.I. specials, if required or as ordered by
Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness.

3.17.4. **THE RATE INCLUDES FOR :**
1. Bib tap and stop cock, special etc.
2. All necessary labour, material and the use of tools.

3.17.5. **MODE OF MEASUREMENT :** The measurement shall be for each unit of bib tap and stop cock fixed.

3.17.6. **MODE OF PAYMENT :** The contract rate shall be for each unit of bib tap or stop cock angle stop cock fixed.

3.18. **PILLAR TAP : (Non fancy & Fancy Type)**

3.18.1. **GENERAL :** The item pertains to provide chromium plated brass pillar tap including fixing.

3.18.2. **MATERIAL :** The pillar tap shall be 15 mm nominal size or as specified in the schedule. Fancy type pillar tap shall be of C.P. brass approved quality and shall conform to I.S. 8931. Non fancy pillar tap shall be chromium plated-brass and shall conform to IS 1795. The nominal size of Pillar tap shall be 15 mm or as specified.

Casting of Pillar tap shall be sound and free from laps, blow hole and pitting. External and internal surface shall be clean, smooth and free from sand and be neatly dressed. All the parts fitted to pillar tap shall be axial, parallel and cylindrical with surfaces smoothly finished. The minimum of finish weight of Pillar tap shall not be less than 650 grams (body weight 250 gms, washer plate loose valve 150 gms and back nut 40 gms. Thickness of C.P coating shall not be less than service grade no.2 of IS 4827 and plating should be capable of taking high polish which shall not easily tarnish or scale.

3.18.3. **TESTING:** Pillar tap shall withstand and internally applied hydraulic pressure of 2 MPa (20 kg/sq.cm) for period of 2 minutes during which period, it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof without any extra cost from the contractor.

3.18.4. **FIXING:** Pillar tap shall be fixed to the pipe line as indicated in the drawing with necessary special as required or as ordered by Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness.

3.18.5. **THE RATE INCLUDES FOR :**
1. Pillar tap including fixing.
2. All necessary labour, material and the use of tools.

3.18.6. **MODE OF MEASUREMENT :** The measurement shall be for each unit of pillar tap fixed.

3.18.7. **MODE OF PAYMENT :** The contract rate shall be for each unit of pillar tap fixed.

3.19. **WASTE COUPLING :**

3.19.1. **GENERAL :** The item pertains to provide chromium plated brass waste coupling including fixing.
3.19.2. **MATERIAL**: Waste Coupling shall confirm to IS 3311. Waste fittings shall be of CP with thickness of CP coating not less than service Grade No.2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect to IS 2963 and shall sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed. The waste fitting for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.

3.19.3. **FIXING**: Waste coupling shall be fixed to wash basin, sink or urinal as ordered with necessary specials. Jointing shall be done with white zinc, yarn etc. A few turns of fine hemp yarn dipped in the linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall be remade to make it leak proof.

3.19.4. **THE RATE INCLUDES FOR**:
1. Waste coupling with necessary specials.
2. All necessary labour, material and the use of tools.

3.19.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of waste coupling fixed.

3.19.6. **MODE OF PAYMENT**: The contract rate shall be for each unit of waste coupling fixed.

3.20. **BOTTLE TRAP**:

3.20.1. **GENERAL**: The item pertains to provide chromium plated brass bottle trap including fixing.

3.20.2. **MATERIAL**: Bottle trap shall be of C.P with thickness of CP coating not less than service grade No. 2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect of IS 2963 and shall be sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed and be truly machined so that nut smoothly moves on the body. The Bottle trap for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.

3.20.3. **FIXING**: Bottle trap shall be fixed to wash basin, sink or urinal as indicated in the drawing with necessary specials or as ordered by the Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall be remade to make it leak proof.

3.20.4. **THE RATE INCLUDES FOR**:
1. Bottle trap with necessary specials.
2. All necessary labour, material and the use of tools.

3.20.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of bottle trap fixed.

3.20.6. **MODE OF PAYMENT**: The contract rate shall be for each unit of bottle trap fixed.

3.21. **COAT AND HAT HOOK**:

3.21.1. **GENERAL**: The item pertains to provide chromium plated brass coat and hat hook including fixing

3.21.2. **MATERIAL**: Coat & Hook shall be of three way type of approved and heavy quality. Coat & Hat Hook shall be CP...
brass and three way hook type or minimum six way patti type of 125 mm x 30 mm x 6mm size. CP coating shall not be less than service grade No.2 of IS 4827.

3.21.3. **FIXING**: The Coat and hat hook shall be fixed to proper line & level as indicated in drawing with CP brass screws.

3.21.4. **THE RATE INCLUDES FOR**:
   1. Coat and hat hook with CP screws etc.
   2. All necessary labour, material and the use of tools.

3.21.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of coat and hat hook fixed.

3.21.6. **MODE OF PAYMENT**: The contract rate shall be for each unit of coat and hook fixed.

3.22. **FLUSHING CISTERN**:

3.22.1. **GENERAL**: The item pertains to provide white or colour glazed chinaware / PVC / Cast Iron flushing cistern with all inside syphonic fitting including fixing.

3.22.2. **MATERIAL**: The flushing cistern shall be automatic or manually of rates high level or low level as specified for water closets and urinals.

Cisterns shall be of cast iron, vitreous china, enamelled pressed steel conforming to IS 774 for Flushing Type and IS 2326 for Automatic flushing cistern and Plastic (IS 7231). Cistern shall be mosquito proof. All working parts shall be designed to operate smoothly and efficiently. The cistern shall have removable covers which shall fit closely on it and be screwed against top displacement where operating mechanism is attached to the cover. This may be made in two section, but the section supporting the mechanism shall be securely fitted or screwed to the body. The outlet fitting of the cistern shall be securely connected to the cistern. The nominal internal diameter of the cistern outlet shall not be less than 32 mm and 38 mm for high level and low level respectively. Length of outlet cistern shall be 37 +/-2 mm. Ball valve shall be screwed type 15 mm in diameter and shall confirm of IS 1703. The flat shall be made of polyethylene as specified in IS 9762. A high level cistern is intended to operate with minimum height of 125 cm and a low level cistern with maximum height of 30 cm between the top of the pan and under side of the cistern. A G.I chain strong enough to sustain a sudden applied pull of 10 kg or a dead load of 50 kg without any apparent or permanent deformation of the chain rings shall be attached to the ring or hook of the level manually operated high level C.I cistern. In case of low level cistern handle shall be of CP brass. In case of Plastic cistern, operation of cistern shall be through Push Button at the top for dual system and beyond plastic handle.

The discharge rate of the cistern as per IS 774 shall be 10 +/- .5 litres 6 second and 5 +/- .5 litres in 3 second for cistern capacity 10 ltrs. and 5 ltrs. respectively. Flush pipe shall be of class ‘B’ G.I pipe of 32 +/- mm diameter for high level. Polyethylene flush pipe shall be low density confirming to IS 3076 or high density confirming to IS 4984 or UPVC pipe confirming to IS 4965 of 40 mm outer diameter. Over flow pipe shall be of G.I. / PVC with mosquito proof jalli of 15 mm dia.

3.22.3. **FIXING**: The chinaware flushing cistern shall be placed over a pair of C.I. brackets. C.P. brass flush pipe shall be fixed to cistern and W.C. pan using check nut, spun yarn, cement mortar etc.

The cast iron flushing cistern shall be placed over a pair of C.I. or G.I. or PVC flush pipe of specified diameter shall be fixed to cistern and W.C. pan by using check nut, white zinc, spun yarn, cement mortar etc.
3.22.4. **THE RATE INCLUDES FOR**:
1. Supply and fixing flush tank, flush pipe and over flow pipe.
2. Painting all the metallic parts with two coats of flat oil paint over a coat of primer.
3. Cutting hole in wall / slab / beam etc. wherever required and making good the same to original condition after fixing.
4. Cost of jointing materials such as zinc, spun yarn, cement mortar 1:1 etc.
5. Testing the entire system and rectification of defects, if any.
6. All necessary materials, labour and use of tools.

3.22.5. **MODE OF MEASUREMENT**: The measurement shall be for each unit of flushing cistern fixed as a whole.

3.22.6. **MODE OF PAYMENT**: The contract rate shall be for each unit flushing cistern fixed as a whole.

3.23. **BRACKET**:

3.23.1. **GENERAL**: The item pertains to provide a pair of bracket for wash basin, sink, flushing cistern etc. including fixing.

3.23.2. **GENERAL**: The item pertains to provide a pair of bracket for wash basin, sink, cistern etc, including fixing.

3.23.3. **FIXING**: Brackets shall be embedded into or fixed to the wall with plugs, screws, nails etc. Hole shall be made in the wall, if they are not left for fixing the brackets and shall be made good after fixing. The gap shall be filled with 1:2 cement mortar and finishing shall be done with white / matching colour cement.

3.23.4. **THE RATE INCLUDES FOR**:
1. Supplying and fixing the brackets.
2. Painting brackets with two coats of flat oil paint over a coat of primer.
3. Cutting hole in wall beam etc. wherever required and making good the same to original condition after fixing.
4. All necessary materials, labour and use of tools.

3.23.5. **MODE OF MEASUREMENT**: The measurement shall be for each pair of bracket fixed included in the items of sink, wash basin, cistern etc. as specified in schedule of quantities.

3.23.6. **MODE OF PAYMENT**: The contract rate shall be for each pair of bracket fixed.

4.0. **WATER SUPPLY SYSTEM**

4.1. **G.I. PIPING WORK (Exposed)**:

4.1.1. **GENERAL**: The item includes provision of G.I. pipes with G.I. fitting of specified nom. bore and class as mentioned in the schedule including laying, fixing. The G.I. pipes and fittings shall run on the surface of the walls or ceilings unless otherwise specified.
4.1.2. **MATERIAL**: The pipes and fittings shall be of M.S. galvanised as specified in the schedule. They shall conform to IS 1239 (P-I). All the pipes and fitting shall have ISI certification mark. The specified nominal bore of the pipe shall refer to inside approximate bore according to the thickness corresponding to outside fixed diameter. The pipe and fittings shall be smooth, sound, free from any imperfections and neatly dressed. The pipe and fitting shall be able to withstand a hydrostatic test pressure of 5 MPa (50 Kg/cm²) maintained for at least 3 seconds at manufacturing works (lab test). The table showing the dimensions and different bores of pipes are given below.

### WEIGHT OF GALVANISED & BLACK (BOTH) M.S. TUBES FOR ORDINARY USES IN WATER CONFORMING TO IS: 1239 (PART-1) 2004

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<th>Bore</th>
<th>Class</th>
<th>Outside Diameter</th>
<th>Wall thickness</th>
<th>Nominal Weight (Kg/M)</th>
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<td></td>
<td></td>
<td>Mm</td>
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<td>in mm</td>
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</tr>
</tbody>
</table>
Random length of tube: unless otherwise specified 4.0 to 7.0 m includes one socket for screwed & socketed tubes

CoATING: Zinc coating as per IS 4736 (latest revision)

4.1.3. LAYING: The plumbing contractor shall set the layout of the plumbing approved by the Engineer-in-charge as may be required by the bye-laws. Pipes shall be laid in plumb and in straight and parallel lines. When unavoidable, pipes may be buried for short distances provided additional protection is given against damage and where so required joints are not buried. Where directed by the Engineer-in-charge, A.M.S. tube sleeve shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion, contraction and other movements. In case the pipe is embedded in walls or floors the pipes shall be painted with anticorrosive bitumastic paints of approved quality. The pipe shall not come in contact with mortar or lime concrete as the pipe is affected by lime. Under the floors the pipe shall be laid in layer of sand filling as done under concrete floors.

4.1.4. FIXING: The entire pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. All pipes shall be fixed truly vertical and horizontal unless unavoidable. The pipe line shall be supported with “U” type G.I. clamps not less than 2 mm thick and G.I. nails not less than 40 mm long, wooden gutties etc. keeping the pipe about 15 mm clear of the wall.

Spacing between clamps for fixing internal piping shall be as per IS 2065 – 1983 as given below:

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<table>
<thead>
<tr>
<th>Mark</th>
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<th>TOLERANCES</th>
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<td>H</td>
<td>“Heavy” class</td>
<td>Red Band</td>
<td>Not limited</td>
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</tbody>
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Mark | Class | Colour Code | TOLERANCES |
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<tr>
<td>M</td>
<td>“Medium” class</td>
<td>Blue Band</td>
<td>Not limited</td>
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<tr>
<td>H</td>
<td>“Heavy” class</td>
<td>Red Band</td>
<td>Not limited</td>
</tr>
</tbody>
</table>

COATING: Zinc coating as per IS 4736 (latest revision)
4.1.5. JOINTING: While fixing the pipe line the joints shall be made by applying a few turns of hemp yarn dipped in linseed oil shall be taken over the threaded end of the pipe and socket screwed home using the pipe wrench, pipe connected shall touch each other and the socket covering each end about equally. The branch connection shall not protrude in the bore of parent pipe.

4.1.6. PAINTING: G.I. pipes and fittings running exposed shall be painted with two coats of oil paint of approved make and shade over a coat of approved primer.

4.1.7. TESTING: The pipes and fittings after they are laid and jointed shall be tested to hydraulic pressure of 1 MPa (10 Kg/sq.cm). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least 2 (two) hours. The pipes and fittings shall be tested in sections as the work of paying proceeds, having the joints exposed for inspection during the testing. Pipes or fittings which are found leaking shall be replaced and joints found leaking shall be redone, without extra payment.

4.1.8. THE RATE INCLUDES FOR:

1. Supplying GI pipes and GI fittings such as sockets, elbows, bends, tees, enlargers, reducers, checknuts, plugs, unions etc. of specified diameter & class including hemp yarn, linseed oil, clamps, screws, wooden gutties etc.
2. Laying, jointing and fixing the pipe with fittings including threading, cutting pipes, wastage etc.
3. All necessary materials, labour and use of tools

4.1.9. MODE OF MEASUREMENT: The measurement shall be for unit running metre length of pipe line of specified nom. bore laid or fixed and shall be taken along center line of the pipe line.

4.1.10. MODE OF PAYMENT: The contract rates shall be for unit running metre length of pipe line of specified nom. bore laid or fixed. No extra payment shall be made for fitting and fixtures.

4.2. G.I. PIPING WORK (Concealed):

4.2.1. GENERAL: The item includes provision of G.I. pipes with concealed type fittings of specified nom. bore and class mentioned in the schedule including laying, fixing, wrapping with hessian cloth, painting and testing.

4.2.2. MATERIAL: Please refer clause 4.1.02
4.2.3. **CHASES**: Chases of size 75 mm x 75 mm shall be cut in the wall, floor, slab wherever required or as directed by chases cutting machine. After testing the pipe line the chases shall be filled with cement mortar 1:3 and surface made good to its original condition.

4.2.4. **LAYING**: The plumbing contractor shall set the layout of the plumbing approved by the Engineer-in-charge as may be required by the bye-laws. Pipes shall be laid in plumb and in straight and parallel lines. No lime plaster or composition containing lime shall be allowed to come in direct contact with the pipe, which are to be concealed as the pipe is affected by lime.

4.2.5. **FIXING**: The entire pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. All pipes and fittings, which are to be concealed, shall be properly embedded in the wall, flooring etc. after being treated. No moulding or plaster design or any ornamental plaster work shall be done over the walls or flooring or ceiling where concealed pipes have been laid.

If the pipe is required to be cut and the end threaded, the burns of the cut end shall be filed smooth and any obstruction in bore shall be entirely eliminated.

4.2.6. **JOINTING**: Please refer Clause No. 4.1.05

4.2.7. **PAINTING**: All the concealed piping work shall be thoroughly painted with two coats of anti-corrosive black bitumastic paint of approved quality shade over a coat of approved primer before concealing and filling the mortar.

4.2.8. **INSULATION**: The hot water pipe line concealed on the wall, floor etc. after painting shall be insulated with 2.5 mm thick 95% asbestos magnesia compound of approved make all round the pipe and fittings.

4.2.9. **WRAPPING**: After painting the cold water pipe line, it shall be wrapped with two layers of hessian cloth of approved quality.

4.2.10. **TESTING**: Please refer clause No.4.1.07

4.2.11. **THE RATE INCLUDES FOR**:

1. Supplying GI pipes and concealed type G.I. fittings such as sockets, elbows, bends, tees, enlargers, reducers, checknuts, plugs, unions etc. of specified diameter and class including hemp yarn, linseed oil etc.
2. Laying, jointing and fixing the pipe with fittings including threading, cutting pipes, wastage, etc.
3. Wrapping the cold water pipe line with hessian cloth including painting and testing.
4. Wrapping the hot water pipe line with asbestos cloth
5. Cutting 75 mm x 75 mm size chases in the wall, floor, slab, etc. and making good the same using 1:3 cement mortar after the pipeline is laid.
6. All necessary materials, labour and use of tools.

4.2.12. **MODE OF MEASUREMENT**: The measurement shall be for unit running metre length of pipe line of specified nom. bore laid or fixed and shall be measured along the center line of the pipe line.

4.2.13. **MODE OF PAYMENT**: The contract rate shall be for unit running metre length of pipe line of specified nom. bore laid or fixed. No extra payment shall be made for fittings and fixtures.

4.4. **PVC PIPING WORK FOR WATER SUPPLY**:
4.5.1. **GENERAL** : The item includes supplying of PVC pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting etc. for vent, over flow, waste water pipe line etc.

4.5.2. **MATERIAL** : The pipes and fittings shall conform to series IV of IS 4985-1978, PVC pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule of quantities.

4.5.3. **EXAMINING** : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

4.5.4. **CLEANING** : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and out side surfaces.

4.5.5. **TRENCHES** : The trench bottom shall be carefully examined for the presence of hard objects such as flints, rock projection or tree roots etc. Pipe shall be embedded in sand or soft soil, free from rock & gravel, back fill 150mm above the pipe shall also be of fine sand or soft soil. Pipe shall not be painted. The width of trench shall not be less than out side diameter of pipe plus 300 mm in case of gravel soils. Pipe shall be laid at-least 900 mm below the ground level (measured from the surface of the ground to the top of pipe).

4.5.6. **LAYING** : The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. All the pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length. The entire length of pipe shall be evenly supported on bed of the trench through out. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall be suitably plugged.

4.5.7. **FIXING** : The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. The pipe shall be fixed with G.I. clamps not less than 2 mm thick or with suitable PVC clamps, The clamps shall be fixed into the wall with G.I. nails not less than 40 mm long and wooden gutties.

| Spacing between clamps for fixing internal piping shall be as given below : |
|-----------------------------|-----------------------------|
| For Horizontal Runs | For Vertical Runs |
| 20 mm | 700 mm | 1050 mm |
| 25 mm | 750 mm | 1125 mm |
| 32 mm | 825 mm | 1240 mm |
| 40 mm | 975 mm | 1460 mm |
| 50 mm | 975 mm | 1460 mm |

4.5.8. **MAKING JOINT** : The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough. The pipe shall be cut to desired length. Care shall be taken that that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.
4.5.9. **DETACHABLE JOINT** : Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

4.5.10. **PAINTING** : If mentioned in schedule of work, the exposed pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer. Underground pipe line shall not be painted.

4.5.11. **DEWATERING** : In case of underground pipes, the contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

4.5.12. **TESTING** : Please refer clause No.4.4.09

4.5.13. **THE RATE INCLUDES FOR :**

1. Supplying of PVC pipes and fittings of specified diameter.
2. Laying and cutting the pipe wherever necessary and wastage.
3. Fixing the pipe line with G.I. clamps not less than 2 mm thick and G.I./M.S. nails length not less than 40mm or with PVC clamps, screws, wooden gutties etc.
4. Making the solution joint, painting the pipe line if mentioned in schedule of quantities.
5. In case of underground piping, dewatering till completion of work.
6. All necessary materials, labour and use of tools.

4.5.14. **MODE OF MEASUREMENT** : The measurement shall be for unit running meter length of pipe line laid or fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting if mentioned in schedule of work and testing.

4.5.15. **MODE OF PAYMENT** : Unit length of pipe line laid or fixed.

4.6. **GUN METAL/ BRASS COPPER ALLOY FULL WAY VALVE** :

4.6.1. **GENERAL** : The item includes provision of full way (gate or globe) valve of specified diameter as mentioned in the schedule including fixing. Full way valve is a valve suitable for controlling or stopping the flow in water supply lines.

4.6.2. **MATERIAL** :

Full way valve shall be of either Brass fitted with a cast iron hand wheel or Gun metal fitted with a C.I. hand wheel or copper alloy as the case may be and shall be of Gate valve type opening full way and of the size as specified conforming to IS 778. The weight of the full way gate valve shall be as per the table given below with a tolerance of 5 percent.

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
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<th>Screwed arch (Kg)</th>
</tr>
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<tr>
<td>15</td>
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<td>32</td>
<td>3.232</td>
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<tr>
<td>40</td>
<td>4.082</td>
<td>2.268</td>
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</tbody>
</table>
4.6.3. **FIXING**: The valves shall be fixed in position in the pipeline as shown in the drawing or as directed with necessary socket or union, nuts etc. The screwed, flanged joint shall be made with few turns of fine hemp yarn dipped in linseed oil taken over the threaded ends to obtain complete water tightness.

4.6.4. **TESTING**: The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm²) along with the testing of pipe line.

4.6.5. **THE RATE INCLUDES FOR**:
1. Valve, G.I. fittings, hemp yarn, linseed oil, zinc, fixing and testing.
2. All necessary labour, materials and use of tools.

4.6.6. **MODE OF MEASUREMENT**: The measurement shall be for each unit valve of specified diameter fixed.

4.6.7. **MODE OF PAYMENT**: The contract rate shall be for each unit of valve of specified diameter fixed. No extra payment shall be made for G.I. fittings used in fixing of the valve.

4.7. **WATER METER**:

4.7.1. **GENERAL**: The item includes provision of Water meter with or without end flanges or non-return valve of specified diameter as mentioned in the schedule with strainer, sockets, flange, union, nuts etc. including fixing and testing.

4.7.2. **MATERIAL**: Water Meter shall conform to IS 779 (Domestic type) or IS 2373 (Bulk type) as specified in Schedule of Quantities and should have ISI certification mark. Non return valve and strainer shall be of the same diameter as that of water meter. Strainer, sockets, flange, union, union nuts, rubber packing etc. shall be as per the description of item.

4.7.3. **FIXING**: Water meter shall be fixed in position on the inlet pipe line and the joints shall be made either screwed or flanged with necessary sockets, flanges and union nuts as required or as directed by the Engineer-in-charge.

4.7.4. **SCREWED JOINT**: A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tight joint.

4.7.5. **FLANGED JOINT**: The flange joint shall be made for flange type water meter and the joint shall be as per the specification of flanged joint.

4.7.6. **TESTING**: The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm²) along with testing of pipe line for a minimum duration of two hours.

4.7.7. **THE RATE INCLUDES FOR**:
1. Water meter, hemp yarn, linseed oil, zinc, fixing and testing.
2. Supplying of strainer non-return valve, sockets, union nut etc.
3. Making screwed or flanged joints.
4. All necessary labour, material and use of tools.
4.7.8. **MODE OF MEASUREMENT** : The measurement shall be for each unit of water meter of specified diameter fixed.

4.7.9. **MODE OF PAYMENT** : The contract rate shall be for each unit Water Meter of specified diameter fixed. No extra payment shall be made towards making flanged and other joints and G.I. fittings used in fixing of the water meter.

4.8. **PRESSURE REDUCING VALVE** :

4.8.1. **GENERAL** : The item includes provision of pressure reducing valve of specified diameter as mentioned in the schedule including fixing.

4.8.2. **MATERIAL** : Pressure reducing valve is a device with suitable means of connection for insertion in a vertical pipe line for controlling the water pressure. Valve shall be of brass and shall be vertical flow type, conforming to IS 9739-1981.

4.8.3. **FIXING** : The valve shall be fixed in position on the pipe line as shown in the drawing or as directed. The screwed or flanged joint shall be made to obtain complete water tight joint.

4.8.4. **TESTING** : The joints shall be tested to a hydraulic pressure of 1MPa (10 kg/cm²) along with testing of pipe line for a minimum duration of 2 hrs.

4.8.5. **THE RATE INCLUDES FOR** :
1. Supplying Valve including fixing and testing.
2. All necessary labour, materials and use of tools.

4.8.6. **MODE OF MEASUREMENT** : The measurement shall be for each unit of valve of specified diameter fixed.

4.8.7. **MODE OF PAYMENT** : The contract rate shall be for each unit of valve of specified diameter fixed.

4.9. **C.I. NON RETURN VALVE** :

4.9.1. **GENERAL** : The item includes supplying of C.I. Non-Return Valve of specified size in the schedule of quantities including fixing.

4.9.2. **MATERIAL** : Non-return valve shall be conforming to IS 9338 or IS 5312 as specified in schedule of quantities. The body, domes, covers, stuffing box, thrust plates, hand wheel, wedges, gland and cap shall be of cast iron not less than of grade FG200 and all in side working parts should be of any non ferrous or ferrous materials such as gun metal. Valve of single door pattern swing type shall have test pressure of PN1.6 (50 to 125 mm size), PN1.0 (150 to 300 mm size), PN0.6 (350 to 600 mm size) as per IS 5312 (part 1). Valve of multi door pattern swing type shall have test pressure of PN0.6 (400 to 1200 mm size), PN1.0 (400 to 1200 mm size) as per IS 5312 (part 2). Valve shall be tested for the body and seat and the defective valve shall be replaced by the contractor at his own cost.

4.9.3. **FIXING** : The C.I. Non-Return valve shall be fixed in position as indicated in the drawing or as directed. They shall be fitted with the tail pieces on both sides by means of flange joints.

4.9.4. **DEWATERING** : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

4.9.5. **TESTING** : The C.I. Non-Return valve shall be fixed in position shall be tested hydraulically to a minimum pressure as
per testing clause of piping work. The testing shall be done along with the testing of pipe line.

4.9.6. **THE RATE INCLUDES FOR**:
1. Supplying and fixing of C.I. Non-Return Valve of specified dia.
2. Dewatering the trench or pit till completion of work.
3. All necessary labour, materials and use of tools.

4.9.7. **MODE OF MEASUREMENT**: The measurement shall be for each unit of Non-Return Valve fixed. Tail piece, making flange joint and lead joint shall be measured under the relevant items.

4.9.8. **MODE OF PAYMENT**: The contract rate shall be for each unit of Non-Return Valve fixed.

4.10. **AIR VALVE**:

4.10.1. **GENERAL**: The item includes supplying of single, double action or kinetic air Valve of specified diameter as mentioned in the schedule including fixing.

4.10.2. **MATERIAL**: The Air Valve shall be of heavy quality conforming to IS 14845 with IS certification mark and isolation valve.. The body, domes, covers, stuffing box, thrust plates, wedges, gland and cap shall be of cast iron not less than of grade 20 and inside working parts should be of any non-ferrous or ferrous materials.

4.10.3. **FIXING**: The Air Valve shall be fixed in position as indicated in the drawing or as directed. They shall be fitted by means of flange joints or screwed joint to the pipe line.

4.10.4. **TESTING**: The Air Valve and the joints shall be tested hydraulically to a minimum pressure as per testing clause of piping work. The testing shall be done along with the testing of pipe line.

4.10.5. **THE RATE INCLUDES FOR**:
1. Supplying and fixing Air Valve of specified diameter and type.
2. Supplying G.I. pipe and fittings if required.
3. All necessary labour, material and use of tools.

4.10.6. **MODE OF MEASUREMENT**: The measurement shall be for each unit of Air Valve fixed C.I. and G.I. specials, making lead or flange joint etc. shall be measured under the relevant items.

4.10.7. **MODE OF PAYMENT**: The contract rate shall be for each unit of air valve fixed.

4.11. **BUTTER FLY VALVE**:

4.11.1. **GENERAL**: The item includes supplying and fixing of butterfly valve of specified diameter as mentioned in the schedule.

4.11.2. **MATERIAL**: The butterfly valve shall be flanged type or as specified conforming to IS 13095 & BS -5155. The valve shall be bubble tight, resilient sealed suitable for flow in either direction with accompanying flanges and steel handle.

4.11.3. **FIXING**: The butterfly valve shall be fixed to the pipe line in position as indicated in the drawing and as directed by the Engineer-In-Charge.
4.11.4. **TESTING:** The valve and the joints shall be tested to a minimum hydraulically pressure of 10kg/sqcm for a duration of two hours or as per testing clause of piping work. The testing shall be done along with the testing of pipe line. The leaky joints shall be rectified to the satisfaction of the Engineer-in-Charge.

4.11.5. **THE RATE INCLUDES FOR:**
1. Supplying and fixing Butterfly Valve of specified diameter.
2. Supplying G.I. pipe and fittings if required.
3. All necessary labour, material and use of tools.

4.11.6. **MODE OF MEASUREMENT:** The measurement shall be for each unit of butterfly Valve fixed. C.I. and G.I. specials, making lead or flange joint etc. shall be measured under the relevant items.

4.11.7. **MODE OF PAYMENT:** The contract rate shall be for each unit of butterfly valve fixed.

5 **DRAINAGE SYSTEM**

5.1. **UPVC-SWR PIPING WORK:**

5.1.1. **GENERAL:** The item includes supplying of UPVC soil, waste and rain water (SWR) and ventilation pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting if required etc.

5.1.2. **MATERIAL:** The pipes shall conforming to IS 13592, UPVC - SWR (Type ‘A’ or ‘B’ as specified) and fittings conforming to IS 13591 shall be free from cracks, flaws and defects and shall be U. V. stabilized and able to withstand a pressure as mentioned in the schedule of work. Rubber sealing rings conforming to IS 5382 with lubricant for sliding socket joints as mentioned in the schedule of work.

5.1.3. **EXAMINING:** Before laying the pipe line, it shall be first examined for damages and cracks. No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

5.1.4. **CLEANING:** All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and out side surfaces.

5.1.5. **LAYING:** The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. All the pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

The entire length of pipe shall be evenly supported on bed of the trench through out. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall be suitably plugged.

5.1.6. **FIXING:** The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. The pipe shall be fixed with G.I. clamps not less than 2.0 mm thick of with suitable UPVC clamps/clips. The clamps/clips shall be fixed into the wall with G.I. nails not less than 40 mm long and wooden gutties keeping the pipe about 15 mm clear of the wall.
5.1.7. **MAKING JOINT**: The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough or rubber sealing rings with lubricant for sliding socket joints. The pipe shall be cut to desired length. Care shall be taken that that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

5.1.8. **DETACHABLE JOINT**: Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

5.1.9. **PAINTING**: In case of underground piping, the pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer.

5.1.10. **DEWATERING**: In case of underground pipes, the contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.1.11. **TESTING**: Please see clause no.5.3.10

5.1.12. **THE RATE INCLUDES FOR**:

1. Supplying of UPVC-SWR pipes and fittings of specified diameter.
2. Laying and cutting the pipe wherever necessary and wastage.
3. Fixing the pipe line with G.I. clamps not less than 2mm thick and G.I./M.S. nails length not less than 40mm or with UPVC clamps, screws, wooden gutties etc.
4. Making the solution joint and painting if mentioned in schedule of work the pipe line.
5. In case of underground pipes, dewatering if necessary till completion of work.
6. All necessary materials, labour and use of tools.

5.1.13. **MODE OF MEASUREMENT**: The measurement shall be for unit running meter length of pipe line laid or fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting if mentioned in schedule of work and testing.

5.1.14. **MODE OF PAYMENT**: The contract rate shall be for unit running meter length of pipe line laid or fixed.

5.2. **PVC PIPING WORK**:

5.2.1. **GENERAL**: The item includes supplying of PVC pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting etc. for vent, over flow, waste water pipe line etc.

5.2.2. **MATERIAL**: The pipes and fittings shall conform to series IV of IS 4985, PVC pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule.

5.2.3. **EXAMINING**: Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

5.2.4. **CLEANING**: All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and out side surfaces.
5.2.5. **LAYING** Please refer clause 4.5.05

5.2.6. **FIXING** : Please refer clause 4.5.06

5.2.7. **MAKING JOINT** : Please refer clause 4.5.07

5.2.8. **DETACHABLE JOINT** : Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

5.2.9. **PAINTING** : If mentioned in schedule of work, the pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer.

5.2.10. **DEWATERING** : In case of underground pipes, the contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.2.11. **TESTING** : Please refer para 5.3.10.

5.2.12. **THE RATE INCLUDES FOR** :

1. Supplying of PVC pipes and fittings of specified diameter.
2. Laying and cutting the pipe wherever necessary and wastage.
3. Fixing the pipe line with G.I. clamps not less than 2mm thick and G.I./M.S. nails length not less than 40mm or with PVC clamps, screws, wooden gutties etc.
4. Making the solution joint and painting the pipe line if mentioned in schedule of work.
5. In case of underground piping, dewatering if necessary till completion of work.
6. All necessary materials, labour and use of tools.

5.2.13. **MODE OF MEASUREMENT** : The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting and testing.

5.2.14. **MODE OF PAYMENT** : The contract rate shall be for unit running meter length of pipe line laid or fixed.

5.3. **GULLY TRAP** :

5.3.1. **GENERAL** : The item includes provision of S.W. Gully trap with C.I. frame including construction of Gully Trap Chamber.

5.3.2. **MATERIAL** : The Gully Trap shall be of salt glazed stoneware with 150 mm nominal square inlet or as specified in the schedule with 100mm diameter outlet. Brick work, plastering, concreting shall be as per general specifications under section-II.

5.3.3. **CONSTRUCTION** :

1. Internal dimension of the Gully trap chamber shall be as specified in the schedule.
2. Foundation of 1:4:8 concrete shall be 150 mm thick, and shall have 100mm offset.
3. Brick masonry shall be of 230 mm thick in cement mortar 1:6 and masonry shall be plastered with 15mm thick plaster in 1:3 cement mortars inside and outside surface with smooth finish.
5.3.4. **C.I. FRAME AND COVER:** C.I. frame and cover shall be fixed with the cement concrete 1:2:4 at the top of Gully trap chamber, the weight of frame and cover shall not be less than 7.5 kg, and they shall be painted with two coats of black bitumastic paint.

5.3.5. **DEWATERING:** The contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.3.6. **THE RATE INCLUDES FOR:**
1. Supplying of stoneware gully trap with C.I. frame and cover.
2. Concreting, brick work, plastering, fixing frame and cover.
3. Dewatering if necessary till completion of work.
4. All necessary materials, labour and use of tools.

5.3.7. **MODE OF MEASUREMENT:** The measurement shall be for unit of Gully Trap chamber of specified internal size and depth constructed including stoneware Gully Trap and C.I. frame and cover fixed.

5.3.8. **MODE OF PAYMENT:** The contract rate shall be for unit of Gully Trap chamber constructed as a whole.

5.4. **C.I. NAHANI / FLOOR TRAP:**

5.4.1. **GENERAL:** The item includes supplying of cast iron nahani / floor trap with CP brass/stainless steel grating of specified diameter with fittings and fixtures including fixing and jointing with the pipe line.

5.4.2. **MATERIAL:** 65 mm nominal outlet dia C I Nahani trap weighing not less than 4.5 kg with an effective water seal of 20 mm or 75mm nom. outlet dia. floor trap (100mm inlet dia.)/ nahani trap (165mm inlet dia.) conforming to IS 3989 or IS1729 shall be provided as specified in the schedule of quantities. Top grating shall be of CP brass or stainless steel of heavy quality of size and shape to suit the trap.

5.4.3. **FIXING:** C.I. nahani/ floor trap with the bend and pipe piece shall be fixed in position over the bed of 1:2:4 cement concrete. The jointing trap and pipe shall be caulked with 1:1 cement mortar. The grating shall be fixed over the nahani / floor trap flush with the floor level and the gap finished with matching cement.

5.4.4. **THE RATE INCLUDES FOR:**
1. C.I. nahani/ floor trap with CP brass or stainless steel grating as specified in the item.
2. Fixing the trap and getting with cement mortar or concrete.
3. All necessary materials, labour and use of tools.

5.4.5. **MODE OF MEASUREMENT:** The measurement shall be for unit of nahani trap fixed.

5.4.6. **MODE OF PAYMENT:** The contract rate shall be for unit of nahani trap fixed.

6. **OVER FLOW COUPLING:**

6.0 **GENERAL:** The item includes supplying of C.P. Brass over flow coupling with mosquito proof jalli of size as specified in the schedule including fixing and painting.

6.1 **MATERIAL:** The overflow coupling shall be of heavy quality. Over flow coupling and Mosquito proof Jalli shall be of
6.2 **FIXING**: The overflow coupling & jalli shall be fixed in position as shown in the drawing with leak proof joints.

6.3 **THE RATE INCLUDES FOR**: 

1. Supplying & fixing Overflow coupling with mosquito proof jalli.
2. All necessary materials, labour, painting and use of tools.

6.4 **MODE OF MEASUREMENT**: The measurement shall be for each overflow coupling fixed with mosquito proof jalli.

6.5 **MODE OF PAYMENT**: The contract rate shall be for each over flow coupling fixed.

7. **BALL VALVE**:

7.0 **GENERAL**: The item includes providing horizontal type ball valve with PVC or copper float of size as mentioned in the schedule including fixing.

7.1 **MATERIAL**: Horizontal plunger type ball valve with PVC or copper float shall be conforming to IS 1703. The lever shall be of brass and may be made in one piece and the diameter of the lever rod shall not be less than the diameter of the thread for boss of ball. Float shall be watertight and non-absorbent and shall not contaminate water. Adhesives for joining the part shall not be used. The minimum thickness for copper sheet of copper float shall be 0.45 mm up to 115 mm diameter and 0.55 mm for ball over 115 mm diameter. Valve shall be tested in closed position to the hydraulic pressure of 2 MPa for a minimum period of 2 minutes without leakage and sweating.

7.2 **MINIMUM MASS**: The minimum mass of finished ball valve and float of different size and class shall be as per Table No. 8 of IS 1703.

7.3 **FIXING**: Valve shall be fixed in position as indicated in the drawing with necessary socket, union nuts etc. as per site requirements. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tight joint. Leaking joint if any shall be rectified to make it leak proof.

7.4 **TESTING**: Testing shall be done along with the testing of pipe line, Separate testing if required shall be done as per ISI norms.

7.5 **THE RATE INCLUDES FOR**: 

1. Supply of specified diameter ball valve with copper or PVC float & brass lever arm, hemp yarn, linseed oil, zinc etc.
2. All necessary materials, labour and use of tools.

7.6 **MODE OF MEASUREMENT**: The measurement shall be for each ball valve fixed.

7.7 **MODE OF PAYMENT**: The contract rate shall be for each ball valve fixed.

8. **POLYETHYLENE WATER TANK**:

8.0 **GENERAL**: The item includes providing polyethylene plastic water tank with cover of capacity as mentioned in the schedule including fixing and making connections such as inlet, outlet, scour, overflow etc.
8.1 MATERIAL: The water tank shall be made out of best moulded Polyethylene plastic. It shall be vertical or horizontal type as specified, watertight and non-absorbent and shall not contaminate water. Adhesives shall not be used in joints. The cover shall be of polyethylene / M.S. / C.I. as approved.

8.2 FIXING: The plastic water tank with cover shall be installed and fixed as per the manufacturer’s specification. The connections such as inlet, outlets, over flow, scour etc. of specified diameter shall be made as mentioned in the schedule including the cost of fittings, fixtures and pipe of approximate 400 mm long.

8.3 THE RATE INCLUDES FOR:

1. Supply of polyethylene plastic tank, cover, G.I. pipe, fittings etc.
2. Installation of tank and making connections.
3. All necessary materials, labour and use of tools.

8.4 MODE OF MEASUREMENT: The measurement shall be for each polyethylene water tank of specified capacity installed or per litre capacity of water tank.

8.5 MODE OF PAYMENT: The contract rate shall be for each polyethylene water tank of specified capacity installed. The support for the tank shall be paid under relevant item.

SECTION – E: FIRE PROTECTION SYSTEM

1. PIPE WORK

1.0 GENERAL REQUIREMENTS

All materials shall be of the best quality conforming to the specifications and subject to the approval of the Consultants.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by suitable clamps and supports (galvanised after fabrication) at intervals specified. Only approved type of anchor fasteners shall be used for RCC slabs and walls / floors etc.

Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.

Pipe accessories such as gauges, meters, control devices, etc. shall have the same working pressure rating as the associated pipe work. All pipe work shall be free from burrs, rust and scale and shall be cleaned before installation. All personnel engaged on welding operations must possess a certificate of competence issued by an acceptable / recognized authority.

1.1 PIPING

Pipes of following types are to be used:

Mild steel black pipes as per IS:1239 heavy grade(for pipes of sizes 150 mm N.B. and below) suitably lagged on the outside to prevent soil corrosion. M.S. pipes buried below ground shall also be suitably be lagged with 4mm thick protection coating over 2 coats of primer.
Steel pipelines up to 150 mm dia shall be as per IS: 1239, Part-II (heavy grade) while pipelines above 150 mm dia shall be as per I.S.: 3589.

All pipe clamps and supports shall be fabricated from MS steel sections and shall be factory galvanised before use at site. Welding of galvanised clamps and supports shall not be permitted.

Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanised nuts and bolts. The size/diameter of the anchor fastener and the clamps shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

Hangers and supports shall be thoroughly galvanised after fabrication. The selection and design of the hanger & support shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchor braces, dampener, expansion joint and structural steel to be attached to the building/structure trenches etc. shall be provided. Hangers and components for all piping shall be approved by the Consultants.

The piping system shall be tested for leakages at 2 times the operating pressure or 1.5 time shut-off pressure, which ever is highest including testing for water hammer effects for a period of 4 hr. minimum.

Flanged joints shall be used for connections for vessels, equipment, flanged valves and also on two straight lengths of pipelines of strategic points to facilitate erection and subsequent maintenance work.

For pipes under ground installation the pipes shall be buried at least one meter below ground level and shall have 230 mm x 230 mm masonry or concrete supports at least 300 mm high at 3m intervals. Masonry work to have plain cement concrete foundation (1 cement: 4 coarse sand : 8 stone aggregate) of size 380x380x75 thick resting on firm soil.

Mains below ground level shall be supported at regular intervals not exceeding 3.0 metres and shall be laid at least 2.0 metre away from the building.

### 1.2 PIPING INSTALLATION & SUPPORT

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on, or suspended from, on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. Risers shall be supported at each floor with Galvanised steel clamps. To permit free movement of common piping support shall be from a common hanger bar fabricated from Galvanised steel sections.

Pipe hangers shall be provided at the following maximum spacings:
### Pipe Dia (mm) | Hanger Rod Dia (mm) | Spacing between Supports (m)
---|---|---
Up to 25 | 6 | 2
32 to 50 | 6 | 2.5
65 to 80 | 8 | 2.5
80 to 100 | 10 | 2.5
125 to 150 | 10 | 3.0
200 to 300 | 12 | 3.5

The end of the steel rods shall be threaded and not welded to the threaded bolt.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fibreglass and finished with retainer rings.

The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size gate valves. Automatic air valves shall be provided on hot water risers.

Discharge from the air valves shall be piped through a pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

Pressure gauges shall be provided as shown on the approved drawings. Care shall be taken to protect pressure gauges during pressure testing.

### 1.3 PIPE FITTINGS
Pipe fittings mean tees, elbows, couplings, unions, flanges, reducers etc and all such connecting devices that are needed to complete the piping work in its totality.
Ductile Iron / Cast Iron / Forged steel screwed type fitting shall be used for pipes of 50 mm dia & below.

Fabricated fittings shall not be permitted for pipes diameters 50mm and below.

Fabricated fittings used on pipe size 65 mm & above shall be fabricated, welded in workshops. They shall be inspected by Project Manager before dispatch from the workshop. The welding procedures of the workshop should have been approved by the rules for sprinkler system and applicable to hydrant and sprinkler system. For “T” connection, pipes shall be drilled and reamed. Cutting by gas or electrical welding shall not be permitted.

1.4 PROCEDURE FOR PYPKOTE / COATEK APPLICATION

A) Surface Preparation - The pipe surface shall be cleaned by a wire brush.

B) Application of Primer - Primer is to be applied on pipes immediately after cleaning. This is to prevent any further accumulation of rust on the pipe. This is a cold applied primer and is applied by brush.

C) Application of 4 mm bitumastic Tape - After the primer is applied on the pipe, it is allowed to dry for about 30 min. till it becomes touch dry. Before adhering the tape to the pipe, it is advisable to gently heat the primer coated pipe by a run of LPG torch. Remove the bottom polyethylene from the tape & then heat bottom surface of the tape by LPG torch or any heat source & start wrapping the tape to the pipe by heating the primer coated pipe & by removing the bottom polyethylene from the tape before wrapping better adhesion between the tape & pipe is obtained. Overlaps are maintained with a minimum of 15.0 mm.

D) Tape coating of weld joints - The tape is applied over the weld joints after the necessary welding & testing methods of the joints is completed. The procedure for application of tape shall be the same as bare pipe procedure. Overlaps on each side of the weld joints shall be 50 mm.

E) A final coat of White wash with water based cement paint is done immediately over the entire coated pipe.

1.5 JOINTING

1.5.1 WELDED JOINTS:
Joints between MS pipes and fittings shall be butt joint made with the pipes and fittings having “V” groove and welded with electrical resistance welding in an approved manner. But welding without “V” groove shall not be permitted.

1.6 GROOVED JOINTS:

1.6.1 Remove all loose dirt scale & grease from the pipe surface.

1.6.2 Wrap the tape around the pipe, make sure the take is not twist & make the groove by machine as per the requirement of coupling manufacturer.

1.6.3 Joints between the pipes and grooved fitting shall be made with the pipe by making square groove by grooving machine without reducing the thickness of pipe wall and fixed with the help of grooved coupling, nut, bolts & gasket etc.
2. VALVES

2.0 SLUICE VALVES
Sluice valves shall be double flanged valves with cast iron body. The spindle, wall seat and wedge nuts shall be of bronze. They shall generally have non-rising spindle and shall be of the particular duty and design called for.

The valves shall be supplied with suitable flanges, non-corrosive bolts and asbestos fibre gaskets. Sluice valves shall conform to Indian Standard IS : 780-1969 and IS : 2906.

2.1 BUTTERFLY VALVE
The butterfly valve shall be suitable for waterworks and rated for 300 P.S.I

The body shall be of cast iron to IS:210 in circular shape and of high strength to take the water pressure. The disc shall be heavy duty cast iron with anti corrosive epoxy or nickel coating.

The valve seat shall be replaceable of high grade elastomer EPDM or nitrile rubber with hard backing. The valve is closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be EN 8 grade carbon steel.

The valve shall be fitted between two flanges on either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

2.2 BALL VALVE
The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.

The ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.

The handle shall be provided with PVC jacket. The handle shall also indicate the direction of ‘open’ and ‘closed’ situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping.

The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

2.3 GUN METAL VALVES
Gun metal Valves shall be used for smaller dia pipes, and for threaded connections. The Valves shall bear certification as per IS:778

The body and bonnet shall be of gun metal to IS:318. The stem gland and gland nut shall be of forged brass to IS:6912. The hand wheel shall be of cast iron to IS:210.

The Hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall be non rising type.

2.4 FLAP TYPE - NON-RETURN VALVE
Non-Return valves shall be cast iron double flanged with cast iron body and gun metal/ S.S. internal parts conforming to IS:5312.

2.5 PRESSURE RELIEF VALVE
Each System shall be provided with a Pressure Relief Valves. The Valve shall be spring actuated and set to operate as per field requirement. The Valve shall be constructed of bronze and provided with an open discharge orifice for releasing the water. The Valve shall be open lift type.

3. PRESSURE SWITCH
The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. The housing shall be die cast aluminium, with SS 316 movement, pressure element and socket. The set pressure shall be adjustable.

The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP:55 water and environment protection.

4. PRESSURE GAUGE
Pressure gauge shall be provided near all individual connections of the hydrant system with isolation valves and near each flow switch assembly of the sprinkler system. Pressure gauge shall be 50 mm dia gunmetal bourdon type with gunmetal isolation ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate height for easy readability.

5. PAINTING
All Hydrant and Sprinkler pipes shall be painted with post office red colour paint. All M S pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat two coats of enamel paint shall be applied. Each coat shall be given minimum 24 hours drying time. No thinners shall be used. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "TO RISER NO.1" etc.

Painting shall be expertly applied, the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

6. ANCHOR / THRUST BLOCK
Contractor shall provide suitably designed anchor blocks in cement concrete/steel support to cater to the excess thrust due to work hammer and high pressure

Thrust blocks shall be provided at all bends, tees and such other location as determined by the Project Manager.

Exact location, design, size and mix of the concrete blocks/steel support shall be as shown on the drawings or as directed by the Project Manager prior to execution of work.

7. FIRE HYDRANTS

7.0 INTERNAL HYDRANTS
a. Contractor shall provide on each landing and other locations as shown on the drawings double headed gunmetal landing valve with 100 mm dia inlet as per IS:5290, with shut off valves having cast iron wheels as shown on the drawings. Landing valve shall have flanged inlet and instantaneous type outlets as shown on the drawings.

b. Instantaneous outlets for fire hydrants shall be standard pattern and suitable for fire hoses.
c. Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric lined hose pipes with gunmetal male and female instantaneous type coupling machine would with GI wire (hose to IS:636 type 2 and couplings to IS:903 with IS certification), fire hose reel, gunmetal branch pipe with nozzle to IS-903. This shall be measured and paid for separately.

d. Contractor shall provide standard fire hose reels of 20mm dia high pressure dunlop rubber hose 36 m long with gunmetal nozzle, all mounted on a circular hose reel of heavy duty mild steel construction having cast iron brackets. Hose reel shall be connected directly to the wet riser with an isolating valve. Hose reel shall conform to IS:884 and shall be mounted vertically. This shall be measured and paid for separately.

e. Each internal hydrant hose cabinet shall be provided with a drain in the bottom plate. The drain point shall be lead away to the nearest general drain.

f. Each internal hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner and a Fireman’s Axe. The cabinet shall be recessed in the wall as directed. This shall be measured and paid for separately.

g. Each hose cabinet shall be conspicuously painted with the letters “FIRE HOSE”.

7.1 HOSE REEL
Hose reel shall conform to IS : 884, heavy duty, 20 mm dia length shall be 36 metre long fitted with gun metal chromium plated nozzle, mild steel pressed reel drum which can swing upto 170 degree with wall brackets of cast iron finished with red and black enamel complete.

7.2 FIRE HOSE
All hose pipes shall be of 63 mm diameter RRL/ CP as required, conforming to IS : 636 or IS : 8423. The hose shall be provided with copper alloy delivery coupling. The hose shall be capable of withstanding a bursting pressure of 35.7 Kg/Sq.cm without undue leakage or sweating. Hose shall be provided with instantaneous spring-lock, type couplings.

7.3 BRANCH PIPE, NOZZLE
Branch pipes shall be of gun metal with loaded tin bronze ring at the discharge and to receive the nozzle and provided at the other with a leaded tin bronze ring to fit into the instantaneous coupling. Nozzle shall be of spray type of diameter of not less than 16 mm and not more than 25 mm. Nozzle shall be of loaded tin bronze branch pipe and nozzle shall be of instantaneous pattern conforming to Indian Standard - 903.

7.4 INTERNAL HOSE CABINET
Hose cabinet shall be of glass fronted with hinged door & lock. The cabinet shall be made of 16 gauge thick MS/SS (as per SOQ) sheet and spray painted to shade No. 536 of IS:5. The hose cabinet shall be of size to accommodate the following:

i. Landing Valves (Single/double headed)

ii. Hose pipe (2 or 4 length of 15M)

iii. Hose reel (36.5 mtr.)

iv. Branch pipes, nozzles (1/2 sets)

v. Fire man’s axe and hand appliances
8. HAND HELD FIRE EXTINGUISHERS

8.0 HAND APPLIANCES

8.0.1 SCOPE

Work under this section shall consist of furnishing all labour, materials, appliances and equipment necessary and required to install fire extinguishing hand appliances as per relevant specification of various authorities.

Without restricting to the generality of the foregoing, the work shall consists of the following:

Installation of fully charged and tested fire extinguishing hand appliances of A B C powder type as required and specified in the drawings and schedule of rates.

8.1 GENERAL REQUIREMENTS

Hand appliances shall be installed in easily accessible locations with the brackets fixed to the wall by suitable anchor fasteners.

Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations. Distribution / installation of fire extinguisher to be in accordance to IS:2190.

8.2 MEASUREMENT

Fire extinguishers shall be counted in numbers and include installation of all necessary items required as given in the specifications.

8.3 ABC TYPE DRY POWDER EXTINGUISHER

The Extinguisher shall be filled with ABC grade 40, Mono Ammonium Phosphate 40% from any approved manufacturer.

The capacity of the extinguisher when filled with Dry Chemical Powder (First filling) as per IS 4308, Part II, shall be 5 Kg +/-2% or 10 Kg +/- 3%.

The distribution of fire extinguishers to be as per IS 2190 – 1992.

It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety clip, fitted with a pin, to prevent accidental discharge. It shall be pressurised with Dry Nitrogen, as expellant. The Nitrogen to be charged at a pressure of 15 Kg/cm²

Body shall be of mild steel conforming to relevant IS Standards. The neck ring shall be also mild steel and welded to the body. The discharge valve body, shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be of brass. The nozzle shall be of brass, while the hose shall be braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.
The Neck Ring shall be externally threaded - the threading portion being 1.6 cm. The filler opening in the neck ring shall not less than 50 mm. Discharge nozzle shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85% of contents upto a throw of 4 mtrs, continuously, at least for 15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 5 Kg capacity and 12 mm for 10 Kg capacity. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside. The extinguisher shall be treated with anti-corrosive paint, and it shall be labelled with words ABC 2.5 cm long, within a triangle of 5 cm on each face. The extinguisher body and valve assembly shall withstand internal pressure of 30 Kg/cm² for a minimum period of 2 minutes. The pressure gauge shall be imported and suited for the purpose.

8.4 WATER TYPE EXTINGUISHER (Gas Pressure Type)

The Extinguishing medium shall be primarily water stored under normal pressure, the discharge being affected by release of Carbon Dioxide Gas from a 120 gms cylinder.

The capacity of Extinguisher, when filled upto the indicated level, shall be 9 ltr +/- 5%

The skin thickness of the Cylinder shall be minimum 4.0 mm, fabricated from Mild Steel sheet, welded as required, with dish and dome, being of same thickness, and of size not exceeding the diameter of body. The diameter of body to be not less than 150 mm and not exceeding 200 mm. The neck shall be externally threaded upto a minimum depth of 16 mm, and leaded tin bronze.

The cap shall be of leaded tin bronze, and screwed on the body upto a minimum of 1.6 cm depth, with parallel screw thread to match the neck ring. The siphon tube to be of brass or G.I. and the strainer of Brass. The cartridge holder, knob, discharge fittings and plunger to be of Brass/Leaded tin bronze, and plunger of stainless steel, spring of stainless steel. The cap to have handle fixed to it. The discharge hose shall be braided nylon, of 10 mm dia and 600 mm long, with a nozzle of brass fitted at end.

The extinguisher shall be treated for anti-corrosion internally and externally, and externally painted with Fire Red paint. The paint shall be stove enamelled/powder coated. The cartridge shall be as per IS, and have 60 gm net carbon dioxide gas for expelling. The extinguisher, body and cap shall be treated to an internal hydraulic pressure of 25 Kg/cm². It shall have external marking with letter A, of 2.5 cm height, in block letters within a triangle of 5 cm each side. The extinguisher shall be upright in operation, with the body placed on ground and discharge tube with nozzle held in one hand to give a throw of not less than 6 mtr, and continue so for atleast 60 secs. The extinguisher body shall be clearly marked with ISI stamp (IS 940).

8.5 CARBON DIOXIDE EXTINGUISHER

The Carbon Dioxide Extinguisher shall be as per IS: 2878

The body shall be constructed of seamless tube conforming to IS:7285 and having a convex dome and flat base. Its dia shall be maximum 140 mm, and the overall height shall not exceed 720 mm.

The discharge mechanism shall be through a control valve conforming to IS:3224. The internal syphon tube shall be of copper aluminium conforming to relevant specifications.

Hose Pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 Kg/cm² and shall be approximately 1.0 meter in length having internal dia of 10 mm. The discharge horn shall be of high quality unbreakable plastic with gradually expanding shape, to convert liquid carbon dioxide into gas form. The hand grip of Discharge horn
shall be insulated with Rubber of appropriate thickness.

The gas shall be conforming to IS:307 and shall be stored at about 85 Kg/cm². The expansion ratio between stored liquid carbon dioxide to expanded gas shall be 1:9 times and the total discharge time (effective) shall be minimum 10 secs and maximum 25 secs.

The extinguisher shall fulfill the following test pressures:
  Cylinder: 236 Kg/cm²
  Control Valve: 125 Kg/cm²

  Burst Pressure of Hose: 140 Kg/cm² minimum

  It shall be an Upright type. The cylinder, including the control valve and high pressure Discharge Hose must comply with relevant Statutory Regulations, and be approved by Chief Controller of Explosives, Nagpur and also bear IS marking.

  The Extinguisher including components shall be IS marked.
SECTION ‘F’- HVAC WORKS
TECHNICAL SPECIFICATIONS

1. VARIABLE REFRIGERANT FLOW / VOLUME

VRF / VRV

General Description
1. All Variable Refrigerant Volume Air Conditioners shall be totally Factory assembled, charged with refrigerant, wired, piped and tested at the factory by OEM.
2. The System shall comprise of Air Cooled scroll, rotary, inverter / digital compressors type Outdoor units, and a variety of indoor units connected by Common Refrigerant Piping,refnets, piping, etc and Power and Control Cabling.
3. All bolts, nuts, screws, washers, plates, etc and all other fittings on all VRV system components shall be plated or passivated to resist corrosion.

VRV/VRF System
1. The VRV System shall provide stable, trouble free and safe operations, and provide flexibility in operation of Indoor Units with independent control of each Indoor Unit, including stepless partial operation.
2. It shall be possible to switch on only those Indoor Units that require Cooling in individual Areas, zones or shops.
3. The capacity of Indoor and Outdoor Units shall be matched, sleeplessly, and shall include multi Compressor cut off / speed control, by pass or any other means of capacity Control for stable operations of System.
4. The System shall be capable of automatic operation even with varying Outdoor and Indoor requirements and make up of low Outdoor Temperatures to achieve lower Power Consumption, without any manual adjustments.
5. All Systems shall be modular in nature, and easily upgradeable / inter connectable for larger capacities.
6. Units shall have hermetically sealed Scroll Compressors, to ensure high EER.
7. The refrigerant gas shall be necessarily R 410a
8. All Units shall be Air Cooled type.
9. The System shall incorporate all required controls for parallel operation of Compressors, Condensers, Fans, and Indoor Units as well as Refrigerant liquid control.

Power Supply
1. All the units shall be suitable for operation with 415V± 10%, 50Hz ± 3%, 3 phase A.C. supply.

Out Door Units
The Condenser coil shall be Air-cooled type with copper tubes and aluminum fins. The condenser coils shall be of adequate size and shall have an integral sub cooler circuit for sub cooling of the liquid. Condenser coil shall have a refrigerant side working pressure of 400 psig with anti-corrosive treatment.

Condenser shall have multiple piping and cabling connection option. Pump down facility should be provided in the refrigerant system by providing good quality hand / shut off valves to avoid loss of Refrigerant gas during maintenance. The condenser fans shall be propeller type, with aluminum blades, low speed, and low vibration levels and quite in operation with IP 55 Protection.

All the compressors of the outdoor units must be hermetically sealed scroll type. Each module of outdoor unit must have separate 1 No. of inverter compressor, suitable to operate at heat load proportional to indoor requirement.

“Anti-Corrosive” treatment (Blue Fins) for Al fins of Condenser Coils is mandatory and shall carry warranty of at least Five (5) years. The treatment should be suitable for areas of high pollution and salt laden air.
The outdoor units must be suitable for more than 150 Meter Refrigerant piping between outdoor unit & the farthest indoor units and total piping of 300 Meter for all the indoor units. Allowable level difference between outdoor unit & indoor units shall be 50 Meter in case of outdoor unit on top & 40 Meter in case of outdoor unit at bottom. Allowable level difference between various indoor units connected to one out door unit shall be up to 15 m.

Back up operation, in case of failure of one of the compressors of outdoor unit, for single module outdoor units or failure of one of the modules in case of multiple modules outdoor units shall be possible. The VRV outdoor unit shall always be supplying at least 33% of back up operation, of the full load capacity.

The outdoor unit shall employ system of equal run time for all the compressors, inverter or on/ off type, within each out door unit – Single Module or Multi Module.

Starter for the Outdoor Unit compressor shall “Direct on Line” type. Inverter compressor of the unit shall start first & at the minimum frequency, to reduce the inrush current during starting.

Refrigerant control in the outdoor unit shall be through Electronic Expansion Valve. Complete refrigerant circuit, oil balancing/ equalizing circuit shall be factory assembled & tested.

The outdoor units shall confirm to Technological Guideline for Harmonic Suppression – JAEG 9702-1995. High Harmonic Environmental Target Level for Power Distribution system shall be 5%.

**Indoor Units**

**Cassette:**
The unit must have in built drain pump, suitable for vertical lift of 750 mm. The unit casing shall be Galvanized Steel Plate. Indoor unit must be insulated with sound absorbing thermal insulation material, Polyurethane foam. The noise level of unit at the highest operating level shall not exceed 45 dB (A), at a vertical distance of 1.5 m from the grille of the unit. Unit shall have provision of connecting fresh air without any special chamber & without increasing the total height of the unit (288 mm maximum). The unit shall be supplied with suitable decorative panel.

The unit shall be supplied with Resin Net filter with Mold Resistance. The filter shall be easy to remove, clean & reinstall. The unit will be connected in series to a suitable out door unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the “Bill of quantities”.

The unit shall be supplied with following from the factory
- Operation Manual
- Installation Manual
- Paper pattern for installation
- Drain hose/ Clamp metal/ Washer fixing plate/ Sealing pads/ Clamps/ Screws/
- Washer for hanging bracket/ Insulation for fitting

**Ducted units:**
The cooling coils shall be made of Copper Tubing having extended aluminum fins. The tubes shall be mechanically expanded for positive bonding between tubes and fins. The cooling coil circuit shall be fed with liquid refrigerant through the expansion device and distributor. The blower shall be statically and dynamically balanced and designed for silent operation at required airflow rates against required static pressure. The filters shall be washable synthetic media type arranged for convenient cleaning and replacement. The drain pan shall be fabricated out of heavy steel sheet. Insulated with expanded polyethylene sheet. The casing shall be of heavy gauge GI, duly powder coated for weather protection.
Hi wall:
With decorative look to match with the interior layout of Corded Remote type complete
In PVC construction. Evaporating unit comprising of DX Cooling coils, blower, electric motor, insulated sandwiched drain Tray, and junction box for electrical connections, 20 micron HDPE washable filter etc.

Remote controls:
Wireless / Corded:
Wired / Cordless remote controller shall be supplied as specified in the “Bill of Quantities”

The controller must have large crystal display screen, which displays complete operating status. The digital display must allow setting of temperature with 1°C interval.

Remote shall be able to individually program by timer the respective times for operation start and stop within a maximum of 72 hours

Remote must be equipped with thermostat sensor in the remote controller that will make possible more comfortable room temperature control The remote shall be able to monitor room temperature & preset temperature by microcomputer & can select cool/heat operation mode automatically. The remote must constantly monitor malfunctions in the system & must be equipped with a “self-diagnosis function” that let know by a message immediately when a malfunction occurs.

In case of corded remote it shall be possible to wire the remote up to 500 RMT.

Group /Central Remote controller / I touch Manager:
Central Control unit shall be suitable for on / OFF and Temperature control of Zones including scheduling, Malfunction and status display shall be available. It should be Compatible with BMS of standard makes. Setting of address for each unit should be automatic and need not be programmed.

Following functions shall be possible
Control Max 64 Groups (128 indoor units)
Zone control
Malfunction code display
All the functions available with wired remote controller It should be possible to wire the remote to 1000m
Central Controller shall be compactable to connect with Fire Detection System

Refrigerant Piping & Insulation:
All refrigerant piping shall be in high grade copper 18 Gauge (1.21 mm) including all connections, Tees, Reducers, etc. Required nos. of Refrigerant joints with insulation should be provided for uniform flow of refrigerant through all Indoor units.

All refrigerant piping shall be insulated with suitable thickness of Closed Cell Elastomeric thermal Insulation material. All joints on the insulation should be sealed with good quality sticking compound. All joints should be covered with 2” wide Aluminum tape. Outersurface of the insulation should come with aluminum foil cladding.

Entire Refrigerant piping inside the building should be installed on the wall / ceiling with proper clamping arrangement and refrigerant piping outside the building (i.e. on Terrace, Shafts) should be properly clamped on MS / GI brackets on the wall of duct / shaft.

Sufficient valving shall be included to allow compressors to be removed for service & to allow the refrigerant to be pumped in to and contained in the condenser. The unit shall be equipped with a liquid line shut off valve, filter drier, liquid line sight
glass, and solenoid valve & insulation where required to prevent condensation forming.

**Electrical Work:**
The electrical work will be carried out as per IE rules. The Employer will provide incoming cable with earthing for each outdoor unit. The further distribution of control cabling and earthing of GI shall be carried out by the contractor.

**Drain Piping:**
Condensate from the Indoor unit shall be drained through properly installed drain piping designed to prevent any accumulation of condensate in the drain pan. Drain piping shall be made of rigid PVC pipe of 6 Kg/cm sq. pressure rating with water tight threaded connections. Leading from the Indoor unit to a suitable drain point. Complete drain piping shall be made leak proof and water tight by means of precise installation and the use of leak proof sealant / adhesives.

**Exposed Roof Insulation:**
The exposed roofs, walls shall be insulated with 50 mm thick fire retarded quality expanded polystyrene from the inside. The material shall be fixed with 85 / 20 grade hot bitumen and GI screw washers. The insulation sheets shall be further fixed with GI diagonal wires and BOPP tapes.

2. **DX REFREGERATION SYSTEM**

**Scope**
The scope of work under this section comprises the supply, erection, testing and commissioning of the refrigeration machines conforming to these specifications and in accordance with the requirements of the Schedule of Equipment.

**Air-Cooled Condensing Units**
1. The packaged air-cooled condensing units shall be designed for outdoor use.
2. The complete unit shall be enclosed in the galvanized steel casing, zinc phosphated including base frame and epoxy coated of approved colour.
3. The packaged air-cooled condensing unit shall be completely factory assembled including all refrigerant piping and internal wiring of all equipments and all controls, mounted on a steel base which shall accommodate the air-cooled condensers, compressors, etc. The unit shall be shipped with a full operating charge of Refrigerant - 22 or Dry Nitrogen while shipping & R-22 charged at site.

**Compressors**
1. The compressors shall be accessible hermetic/semi hermetic reciprocating type with all rotating parts statically and dynamically balanced. Compressors shall have forced feed Lubrication System using a reversible positive displacement type oil pump. The compressor shall also include a suction strainer, oil strainer, crankcase oil heaters, and back seating seal-cap type suction and discharge stop valves.
2. The compressor motor shall be operated and protected against electrical overload by means of definite purpose contactors and calibrated, ambient compensated, magnetic-trip circuit breakers. The circuit breakers shall open all 3 phases in the event of overload, single phasing or phase reversal and shall be manually reset.
3. The capacity control system shall modulate compressor capacity automatically in at least 4 steps. The
unloading shall be controlled by a solid state controller.

4. The compressors shall be mounted on non-corrodable spring isolators and the unit further mounted on non-corrodable spring isolators.

**Condensers**

1. The air-cooled condenser coils shall have aluminum fins mechanically bonded to seamless copper tubes, cleaned, dehydrated, sealed, leak tested at (150 psig) and pressure tested at (450 psig).

2. Condenser fans shall be propeller type Low noise type with epoxy coated galvanized steel wire safety guards. The complete fan assembly shall be balanced statically and dynamically. The air shall be discharge vertically upwards.

3. The fan blades shall be cast aluminum. Each fan shall be driven directly by an individual weatherproof motor.

4. The condenser fan motors shall be of 3 phase IP-55, high torque type having inherent over current protection, ball bearing construction and permanently lubricated.

**Refrigerant Components**

1. The refrigerant circuit components shall include hot gas muffler, high side pressure relief discharge device, liquid line shutoff valves, replaceable core filter drier, moisture indicating sight glass, and Thermostatic expansion valve. The expansion valves shall have maximum operating pressure characteristics to limit inlet suction pressure.

The entire suction line and liquid line between the expansion valve and the chiller shall be insulated with close cell insulation.

**Controls**

1. Controls shall be factory mounted and wired in a weatherproof enclosure with hinged access doors with easy access. All units shall have low and high suction protection for each circuit, low oil protection for each circuit, individual solid-state protection board and ground current protection. All units shall have low control voltage to unit, field power and control circuit terminal blocks, compressor and fan motor circuit breakers, control circuit breakers, ON-OFF switch etc.

2. The controls shall also have a provision for wiring in remote on-off switch.

3. The power terminals shall be capable of accepting aluminum or copper cables.

### 3. INSULATION

**Scope**

1. The Scope of this section comprises supply and fixing of insulation as specified.

2. All insulating materials in the form in which it is used and under the condition anticipated shall not ignite, burn, support combustion or release toxic gases when subject to fire or heat.

3. All adhesives used to stick insulation shall also be non-flammable.

4. All materials used for thermal and acoustical insulation shall be resin bonded fibre glass of density and thickness as specified or indicated on the drawing.
5. All sun exposed roof shall have Phenotherm under deck insulation of the density and thickness specified.

6. Manufacturers’ recommendation for application & safety shall be strictly adhered to.

**Duct Insulation**

1. Thermal Duct Insulation – Nitrile rubber class ‘O’

2. Insulation material for ducts shall be close cell elastomerics nitrile rubber class ‘O’. Thermal conductivity of nitrile rubber shall not exceed 0.036 W/m°C. Density of material shall not be less than 0.04 gm/cm³.

3. 9mm thick of supply air duct in conditioned space.

4. 15 mm thick for supply air in non-conditioned space.

5. The insulation shall be applied as follows:

**Duct Insulation – Thermal**

1. Clean all duct surfaces thoroughly to remove grease, dirt etc.

2. The measurement of surface dimension shall have to be taken properly to cut nitrile rubber sheets.

3. The rubber sheets size to cut with sufficient allowance in dimension. A single sheet should be cut, so as to provide only one seam at the top of the duct. No small patches shall be allowed.

4. Apply a thin coat of non-flammable adhesive recommended by manufacturer on ducts and on the insulation material.

5. All longitudinal and transverse joints shall be sealed with 3mm thick and 25mm width self-adhesive Armaflex class ‘O’ tape.

**Acoustical Insulation**

**Acoustical Insulation for Ducts**

1. All connecting ducts to Package Units / AHUs shall be sound insulated to a distance of 6 m or as specified or as shown on the design.

2. Acoustical insulation shall be 50 mm thick 32 Kg/cum Fibre Glass Insulation finished with dimensionally stable Black Glass Tissue (BGT) facing & 24 G perforated aluminum sheets as specified or shown on the drawings.

**Application**

1. Clean all internal duct surfaces.

2. Pre-cut the insulation to the size desired, allowing 50 mm excess at downstream joints.

3. Install self-adhesive pins spaced along the inner face of duct. The pins should start within 75 mm of upstream transverse edges of the liner and 75 mm from longitudinal joints and should be placed at a maximum of 300 mm on centres around the perimeter of the duct, except that there may be a maximum of 300 mm from a corner break.

4. Apply coat of Foster Ductfas Adhesive 81 - 22 on the duct surfaces as per manufacturer’s recommendations.
5. Impale insulation through the pins and assure insulation is stuck to the adhesive.

6. Fix self-retaining washers on to the pins. Do not compress insulation more than 3 mm.

7. Bend the pins so as to prevent protrusions or tears

8. It is recommended that all exposed leading edges & joints be coated with Foster Duct as Adhesive 81 - 22.

**Acoustical Insulation for AHU / Package Unit Rooms**

1. Acoustical insulation shall be 50 mm thick 32 Kg/cum Fiber Glass Insulation finished with dimensionally stable Black Glass Tissue (BGT) facing & 24 G perforated aluminum sheets as specified or shown on the drawings.

**Application**

1. Fix 50 mm x 50 mm GI / Al. angle frame at 600 mm centers.

2. Fix insulation + BGT & finish with 24G perforated aluminum sheets.

4. **VENTILATION AND EXHAUST**

**Scope:**

1. Scope of work under this section comprises the supply, erection, testing and commissioning of the ventilation / exhaust system of the capacities set forth in the Schedule of Equipment.

2. All fans shall be static and dynamically balanced.

**Centrifugal Fans:**

1. Fans shall be 'Buffalo' or equivalent, non-overloading type. The fan C.F.M. static pressure, class arrangement, width, direction of rotation, mode of discharge, etc. shall be as indicated in the Schedule of Equipment and in the applicable drawings or as required.

2. The scroll shall be manufactured from hot dip galvanized sheet steel with side plates of Aero-dynamic profile.

3. Fans shall be provided with stationary inlet vanes as a standard accessory. Movable inlet vanes shall be provided only where specified for automatic control. Movable inlet vanes shall be complete with necessary linkages for actuation by automatic controls.

4. Fans shall also be provided with heavy duty outlet dampers mounted in a separate frame, wherever required.

5. All Class I fans shall be provided with sleeves bearing with generous oil reservoir, drain plug, oil level indicator, etc. Class II and III fans shall be provided with heavy duty ball bearings pre-greased & self -aligning.

6. Fans shall be driven by electric motor as specified in the Schedule of Equipment. Motor ratings are only tentative and where a fan requires a higher capacity motor, the Contractor shall clearly point out the requirements and make his offer accordingly. Motor ratings shall be at least 5% over limit load plus transmission losses.
7. Exhaust fans handling corrosive fumes shall be made of non-corrosive materials or coated with corrosion resistant paints with epoxy of chlorinated rubber base.

**Cabinet Supply/Exhaust Units:**

1. Units shall be complete factory assembled, tested and of approved manufacturers.

2. Casing shall be of heavy gauge galvanized sheets, ribbed and reinforced with access provided by hand holes and casing panels.

3. Fans shall be driven by an electric motor as specified in the Schedule of Equipment. Motor ratings are only tentative and where a fan requires a higher capacity motor, the Contractor shall clearly point out the requirements and make his offer accordingly. Motor ratings shall be at least 5% over transmission losses.

4. Fan shall have limit switch with Aluminium wire guard to shut off the fan.

**Smoke Exhaust Centrifugal Fans**

1. Standard with UL listing for "Power ventilators for Smoke control Systems" for 500 degrees F for 4 hours and 1000 Degrees F for 15 min. Units have centrifugal backward inclined steel wheels with embossments on the blades and cooling fins for added strength and cooling. Flange Safety Vibration Isolators are oversized to accommodate the added heat and weight. Unit has heat baffle to reduce motor compartment temperature. Unit shall have dual Belt and Pulley system.

2. Fans shall bear the AMCA Certified Ratings Seal for sound and air performance.

3. Each fan shall bear a permanently affixed manufacturer’s name plate containing the model number and individual serial number for future identification.

**Tube Axial Fans (Direct Drive):**

1. The fans shall be selected for heavy-duty operation. Fan housing shall be one-piece rugged steel construction. The fan shall be in accordance with IS-2312

2. Inline Ducted Tube Axial Fans in PP construction and coated with direct drive TEFC Sq.cage induction motor and mounting brackets with nuts bolts etc. The frame work should be suitable for wall mounting.

3. The motor shall be Flameproof / Non-Flameproof type & totally enclosed type, with capacitor start and run type motor, rated for continuous duty and rugged in construction. The motor shall have pre lubricated double ball bearing and shall be provided with class A / E insulation.

**Testing And Balancing**

1. After the installation of the entire system is completed in all respects, system shall be tested & balanced for required performance. Fan shall be tested for the performance and test results shall be furnished.

**Painting**

1. On completion of the erection and testing, fans shall be painted with the two coats of an appropriate paint of approved color.

**FILTERS :**

1. Filters shall be non-flammable 90% efficiency down to 10 microns. Filters shall be cleaned by dusting or reverse
Installation:
The concrete foundations required for the fans shall be prepared by the Owner to the drawings supplied by the Contractor. However, the Contractor shall supply all foundation bolts, base plate, wherever required, vibration eliminators, etc. and shall also ensure that all the above accessories are placed securely in proper position while the foundation is cast.

Vibration eliminators shall be provided with an efficiency of not less than 80%.
Fan inlet and outlet connections shall be by means of flexible canvas connections.
Fan belt drive shall be complete with belts, belt, sheaves and suitable belt guard.

For all kitchen exhaust or any other high temperature exhaust, flexible connection at the fan inlet and outlet shall be of double lobe grease and fire resistant Neoprene sheets.

Grease – tight access panels of sufficient size and shall have to be provided with 50 mm drain plug at the bottom of the fan for grease removal.

Testing:
1. Fan shall be tested for the performance and test results shall be furnished as given in Section TEST READINGS.

Painting:
1. On completion of the erection and testing, fans shall be painted with the two coats of an appropriate paint of approved color.

5. SHEET METAL WORK

Option – I (Factory Fabrication As Per Smacna Standards)

Scope
The scope of this section comprises supply fabrication, installation and testing of all sheet metal / aluminum ducts, supply, installation, testing and balancing of all grilles, registers and diffusers. All to be in accordance with these specifications and the general arrangement shown on the Drawings

Duct Materials

Raw Materials
Galvanizing shall be Class VII – light coating of zinc, nominal 180g/m² surface area and Lock Forming Quality prime material along with mill test certificates. In addition, if deemed necessary, samples of raw material, selected at random by owner’s site representative shall be subject to approval and tested for thickness and zinc coating at contractor’s expense.

Gauges, Bracing By Size Of Ducts
All ducts shall be fabricated from galvanized steel / aluminum of the following thickness, as indicated as below:
For Ducts with external SP upto 250 Pa (To be used for Hotels & Commercial Projects)

<table>
<thead>
<tr>
<th>Maximum Duct Size</th>
<th>Gaug e</th>
<th>Joint Type</th>
<th>Bracing Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–750 mm</td>
<td>26</td>
<td>C &amp; S/ SS</td>
<td>Nil</td>
</tr>
<tr>
<td>751 – 1000 mm</td>
<td>26</td>
<td>4 Bolt Transverse Duct Connector-(TDC) / Slip-on E</td>
<td>Nil</td>
</tr>
<tr>
<td>1001 – 1200 mm</td>
<td>24</td>
<td>4 Bolt TDC / Slip-on E</td>
<td>Nil</td>
</tr>
<tr>
<td>1201 – 1500 mm</td>
<td>24</td>
<td>4 Bolt TDC / Slip-on F</td>
<td>Nil</td>
</tr>
<tr>
<td>1501 – 1800 mm</td>
<td>22</td>
<td>4 Bolt TDC / Slip-on H</td>
<td>Nil</td>
</tr>
<tr>
<td>1801 – 2100 mm</td>
<td>20</td>
<td>4 Bolt TDC / Slip-on I</td>
<td>Zeebar Stiffener 1-S</td>
</tr>
<tr>
<td>2101 – 2700 mm</td>
<td>18</td>
<td>4 Bolt TDC / Slip-on I</td>
<td>Zeebar Stiffener 1-S</td>
</tr>
</tbody>
</table>

OR

For Ducts with External SP upto 500 Pa (For Hospital & Clean room jobs, where AHU SP is specified as 75 mm and above. Not Suitable for OTs)

<table>
<thead>
<tr>
<th>Maximum Duct Size</th>
<th>Gaug e</th>
<th>Joint Type</th>
<th>Bracing Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–600 mm</td>
<td>26</td>
<td>C &amp; S/ SS</td>
<td>Nil</td>
</tr>
<tr>
<td>601-750 mm</td>
<td>26</td>
<td>4 Bolt Transverse Duct Connector-(TDC) / Slip-on E</td>
<td>Nil</td>
</tr>
<tr>
<td>751-1000 mm</td>
<td>24</td>
<td>4 Bolt TDC / Slip-on F</td>
<td>Nil</td>
</tr>
<tr>
<td>1001-1200 mm</td>
<td>22</td>
<td>4 Bolt TDC / Slip-on G</td>
<td>Nil</td>
</tr>
<tr>
<td>1201-1300 mm</td>
<td>20</td>
<td>4 Bolt TDC / Slip-on H</td>
<td>Nil</td>
</tr>
<tr>
<td>1301-1500 mm</td>
<td>18</td>
<td>4 Bolt TDC / Slip-on H</td>
<td>Zeebar Stiffener 1-S</td>
</tr>
<tr>
<td>1501-1800 mm</td>
<td>18</td>
<td>4 Bolt TDC / Slip-on I</td>
<td>Zeebar Stiffener 1-S</td>
</tr>
<tr>
<td>1801-2100 mm</td>
<td>18</td>
<td>4 Bolt TDC / Slip-on J</td>
<td>Zeebar Stiffener 2-S</td>
</tr>
<tr>
<td>2101-2250 mm</td>
<td>18</td>
<td>4 Bolt TDC / Slip-on J</td>
<td>Zeebar Stiffener 2-S</td>
</tr>
<tr>
<td>2251-2400 mm</td>
<td>18</td>
<td>4 Bolt TDC / Slip-on J</td>
<td>Zeebar Stiffener 2-S</td>
</tr>
<tr>
<td>2401-2700 mm</td>
<td>18</td>
<td>4 Bolt TDC / Slip-on J</td>
<td>Zeebar Stiffener 2-S</td>
</tr>
</tbody>
</table>

'C'-cleat; 'S'-S cleat; 'SS'-Standing S cleat;
*Distance of reinforcement/bracing from each joint. Bracing material to be same as of material used for joining of duct sections.

For Aluminum Ducts Material Shall Be One Commercial Gauge Higher With 22 G as Minimum

**Fabrication Standards & Equipment**

All duct construction and installation shall be in accordance with SMACNA standards. In addition ducts shall be factory fabricated utilizing the following machines to provide the requisite quality of ducts.

1. **Coil (Sheet metal in Roll Form) lines to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.**
2. All ducts, transformation pieces and fittings to be made on CNC profile cutter for requisite accuracy of dimensions, location and dimensions of notches at the folding lines.
3. All edges to be machine treated using lock formers, flanges and rollers for turning up edges.

**Duct Construction**

All ducts shall be fabricated and installed in workmanlike manner, conforming to relevant SMACNA codes.

Ducts so identified on the Drawings shall be acoustically lined and insulated from outside as described in the section "Insulation" and as indicated in schedule of Quantities. Duct dimensions shown on drawings, are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in Schedule of quantities. The fabricated duct dimensions should be as per approved drawings and care should be taken to ensure that all connecting sections are dimensionally matched to avoid any gaps.

Ducts shall be straight and smooth on the inside with longitudinal seams shall be airtight and at corners only which shall be either Pittsburgh or snap button as per SMACNA practice, to ensure airtightness.

All ducts up to 75cms width within conditioned spaces shall have slip and drive (C & S/SS) joints. The internal ends of slip joints shall be in the direction of airflow. Care should be taken to ensure that S/SS Cleats are mounted on the longer side of the duct and Cleats on the shorter side. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint.

Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Air-turns (vanes) shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

Ducts shall be fabricated as per details shown on Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans, shall be constructed of 18 gauge GSS / 16gauge aluminum, thoroughly stiffened with 25mm x 25mm x 3mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Access doors shall be not less than 45cm x 45cm in size.

Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside.
Self adhesive Neoprene rubber / UV resistant PVC foam lining 5mm nominal thickness instead of felt, shall be used between duct flanges and between duct supports in all ducting installation.

Installation Practice

All ducts shall be installed generally as per tender drawings, and in strict accordance with approved shop drawings to be prepared by the Contractor:

The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these Specifications and Drawings. The work shall meet with the approval of Owner’s site representative in all its parts and details

All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building, whether or not the same are shown on the drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and conduits, the ducts shall be transformed, divided or curved to one side (the required area being maintained) all as per the site requirements.

If a duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available in accordance with other services and as per approval of owner’s site representative.

All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel rod under ducts. The spacing between supports should be not greater than 2.0 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats or fully threaded galvanized rods can be screwed into the anchor fasteners.

Ducting over furred ceiling shall be supported from the slab above, or from beams after obtaining approval of Owner’s site representative. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor’s work in the building.

Where ducts pass through brick or masonry openings, it shall be provided with 25mm thick TF quality expanded polystyrene around the duct and totally covered with fire barrier mortar for complete sealing.

All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 10cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top.
Dampers

a. Dampers: All duct dampers shall be opposed blade louver dampers of robust 16 G GSS construction and tight fitting. The design, method of handling and control shall be suitable for the location and service required.

b. Dampers shall be provided with suitable links, levers, and quadrants as required for their proper operation. Control or setting device shall be made robust, easily operable, and accessible through suitable access door in the duct. Every damper shall have an indicating device clearly showing the damper position at all times.

c. Dampers shall be placed in ducts at every branch supply or return air duct connection, whether or not indicated on the Drawings, for the proper volume control and balancing of the air distribution system.

Fire & Smoke Dampers

a. All supply and return air ducts at AHU room crossings and at all floor crossings shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating as per UL555/1995 tested by CBRI. These shall be of multi-leaf type and provided with Spring Return electrical actuator having its own thermal trip for ambient air temperature outside the duct and air temperature inside the duct. Actuator shall have Form fit type of mounting, metal enclosure and guaranteed long life span.

b. Fire damper blades and outer frames shall be of 16G galvanized steel construction fitted with 18 gage extended sleeves on both sides. The damper blade shall be pivoted on both ends using chrome plated spindles in self lubricated bronze bushes. Stop seals shall be provided on top and bottom of the damper housing made of 16G galvanized sheet steel. For preventing smoke leakage metallic compression seals will be provided.

c. The electric actuator shall be energized either upon receiving a signal from smoke detector installed in AHU room supply air duct / return air duct or temperature sensor. The fire damper shall also close upon sensing temperature rise in supply air ducts thru the electronic temperature sensor.

d. Each damper shall be provided with its own control panel, mounted on the wall and suitable for 240 VAC supply. This control panel shall be suitable for spring return actuator and shall have at least the following features:

- Potential free contacts for AHU fan ON/Off and remote alarm indication.
- Accept signal from external smoke/fire detection system for tripping the electrical actuator.
- Test and reset facility.
- Indicating lights/contacts to indicate the following status:
  - Power Supply On
  - Alarm
  - Damper open and close position.

e. Actuators shall be mounted on the sleeve by the damper supplier in his shop and shall furnish test certificate for satisfactory operation of each Motor Operated Damper in conjunction with its control panel. Control panel shall be wall mounted type.
f. It shall be HVAC Contractor’s responsibility to co-ordinate with the Fire Alarm System Contractor for correctly hooking up the Motor Operated Damper to Fire Detection / Fire Management System. All necessary materials for hooking up shall be supplied and installed by HVAC Contractor under close co-ordination with the fire protection system contractor.

g. HVAC Contractor shall demonstrate the testing of all Dampers and its control panel after necessary hook up with the fire protection / fire management system is carried out by energizing all the smoke detectors with the help of smoke.

h. HVAC Contractor shall provide Fire retardant cables wherever required for satisfactory operation and control of the Damper.

j. HVAC Contractor shall strictly follow the instructions of the Damper Supplier or avail his services at site before carrying out testing at site.

k. Fire/smoke damper shall be provided with factory fitted sleeves; however, access doors shall be provided in the ducts within AHU room in accordance with the manufacturer’s recommendations.

l. The Contractor shall also furnish to the Owner, the necessary additional spare actuators and temperature sensor (a minimum of 5% of the total number installed) at the time of commissioning of the installation.

Fire Dampers

a. Whenever a supply/return duct crosses from one fire zone to another, it shall be provided with approved fire damper of at least 1½ hour fire rating as per UL555/1995 tested by CBRI. This shall be curtain type fire damper.

b. Fire damper blades shall be one piece folded high strength 16 gage galvanized steel construction. In normal position, these blades shall be gathered and stacked at the frame head providing maximum air passage and preventing passing air currents from creating noise or chatter. The blades shall be held in position through fusible link of temp 70o C.

c. In case of fire, the intrinsic energy of the folded blades shall be utilized to close the opening. The thrust of the suddenly released tension shall instantly drive the blades down and keep it down without the use of springs, weights or other devices subject to failure.

d. Fire damper sleeves and access doors shall be provided within the duct in accordance with the manufacturer’s recommendation.

e. The contractor shall also furnish to the Owner, the necessary additional fusible links (spares), as recommended by the manufacturer, at the time of commissioning of the installation.

Supply And Return Air Grilles

Supply & return air grilles shall be of either steel or aluminum sections as specified in schedule of quantities. Steel construction registers shall have primer Coat finish whereas extruded aluminum grilles / registers shall be either Anodized Powder Coated as specified in Schedule of Quantities. These registers shall have individually adjustable louvers both horizontal and vertical. Supply air registers shall be provided with key operated opposed blade extruded aluminum volume control damperanodized in matt black shade.

The grilles / registers shall be suitable for fixing arrangement having concealed screws as approved by Architect. Linear continuous supply cum return air register shall be extruded aluminum construction with fixed horizontal bars at 15 Deg.
inclination & flange on both sides only (none on top & bottom). The thickness of the fixed bar louvers shall be minimum 5.5 mm in front and 3.8 mm in rear with rounded edges. Flanges on the two sides shall be 20 mm/30 mm wide as approved by Architect. The grilles shall be suitable for concealed fixing. Volume control dampers of extruded aluminum, anodized in black color shall be provided in supply air duct collars. For fan coil units, horizontal fixed bar grilles as described above shall be provided with flanges on four sides, and the core shall be suitable for clip fixing, permitting its removal without disturbing the flanges.

a. All registers shall be selected in consultation with the Architect. Different spaces shall require horizontal or vertical face bars, and different width of margin frames. These shall be procured only after obtaining written approval from Architect for each type of register.

b. All registers shall have a soft continuous rubber/foam gasket between the periphery of the register and the surface on which it has to be mounted. The effective area of the registers for air flow shall not be less than 66 percent of gross face area.

c. Registers specified with individually adjustable bars shall have adjustable pattern as each grille bar shall be pivotable to provide pattern with 0 to +45 degree horizontal arc and up to 30 degree deflection downwards. Bars shall hold deflection settings under all conditions of velocity and pressure.

d. Bar longer than 45 cm shall be reinforced by set-back vertical members of approved thickness.

e. All volume control dampers shall be anodized aluminum in mat black shade.

f. In case of continuous grilles/diffusers, dummy grilles shall be blanked-off using GI sheet duly painted black.

g. All square/rectangular diffusers, slot diffusers to have insulated plenum installed above dampers from OEM factory & not to be constructed at site.

Supply And Return Air Diffusers

Supply and return air diffusers shall be as shown on the Drawings and indicated in Schedule of Quantities. Mild steel diffusers/dampers shall be factory coated with rust-resistant primer. Aluminum diffusers shall be powder coated & made from extruded aluminum section as specified in schedule of quantities.

a. Rectangular Diffusers shall be steel/extruded aluminum construction, square & rectangular diffusers with flush fixed pattern for different spaces as per schedule of quantities. These shall be selected in consultation with the Architect. These shall be procured only after obtaining written approval from Architect for each type of diffuser.

b. Supply air diffusers shall be equipped with fixed air distribution grids, removable key-operated volume control dampers, and anti-smudge rings as required in specific applications, and as per requirements of schedule of quantities. All extruded aluminum diffusers shall be provided with removable central core and concealed key operation for volume control damper.

c. Linear Diffuser shall be extruded aluminum construction with removable core, one or two way blow type. Supply air diffusers shall be provided with volume control/balancing dampers within the supply air collar. Diffusers for different spaces shall be selected in consultation with the Architect, and provided as per requirements of schedule of quantities. All diffusers shall have volume control dampers of extruded aluminum construction anodized in mat black shade.
Slot Diffuser shall be extruded aluminum construction multiport type with air pattern controller provided in each slot. Supply air diffusers shall be provided with Hit & Miss volume control dampers in each slot of the supply air diffusers. Diffusers for different spaces shall be selected in consultation with the Architect and provided as per requirement of Schedule of Quantities.

Documentation & Measurements For Ducting

All ducts fabricated and installed should be accompanied and supported by proper documentation viz:

a) Bill of material/Packing list for every duct section supplied.

Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

Each and every duct piece to have a tag number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement and verification.

Unless otherwise specified, measurements for ducting for the project shall be on the basis of centerline measurements described herewith

Ductwork shall be measured on the basis of external surface area of ducts. Duct measurements shall be taken before application of the insulation. The external surface area shall be calculated by measuring the perimeter comprising overall width and depth, including the corner joints, in the center of each duct section, multiplying with the overall length from flange face to flange face of each duct section and adding up areas of all duct sections. Plenums shall also be measured in a similar manner.

For tapered rectangular ducts, the average width and depth shall be considered for perimeter, whereas for tapered circular ducts, the diameter of the section midway between large and small diameter shall be adopted, the length of tapered duct section shall be the centerline distance between the flanges of the duct section.

For special pieces like bends, tees, reducers, branches and collars, mode of measurement shall be identical to that described above using the length along the centerline.

The quoted unit rate for external surface of ducts shall include all wastage allowances, flanges and gaskets for joints, nuts and bolts, hangers and angles with double nuts for supports, rubber strip 5mm thick between duct and support, vibration isolator suspension where specified or required, inspection chamber/access panel, splitter damper with quadrant and lever for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall NOT be separately measured nor paid for.

b) Special Items for Air Distribution shall be measured by the cross-section area perpendicular to air flow, as identified herewith:

i. Grilles and registers - width multiplied by height, excluding flanges. Volume control dampers shall form part of the unit rate for registers and shall not be separately accounted.

ii. Diffusers - cross section area for air flow at discharge area, excluding flanges. Volume control dampers shall form part of unit rate for supply air diffusers and shall not be separately accounted.
iii. Linear diffusers - shall be measured by cross-sectional areas and shall exclude flanges for mounting of linear diffusers. The supply air plenum for linear diffusers shall be measured with ducting as described earlier.

iv. Fire dampers - shall be measured by their cross-sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary collars and flanges for mounting, inspection pieces with access door, electrical actuators and panel. No special allowance shall be payable for extension of cross section outside the air stream.

v. Flexible connection - shall be measured by their cross-sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary mounting arrangement, flanges, nuts and bolts and treated-for-fire requisite length of canvas cloth.

vi. Kitchen Hoods - shall be measured by their cross-sectional area at the capture point of fumes, parallel to the surface of kitchen equipment. Quoted rates shall include the grease filters, provision for hood light, suspension arrangement for the hood, profile to direct the air to ventilation ducts and provision for removable drip tray.

Testing And Balancing

After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks by visual inspection as per SMACNA standards.

The entire air distribution system shall be balanced using an anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less/excess than 5 percent in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval, and four copies of the approved balance report shall be provided with completion documents.

Option- II (Site Fabrication)

AIR DISTRIBUTION

(AS PER "BIS" STANDARD)

1 SCOPE

The scope of this section comprises supply fabrication installation and testing of all sheet metal / aluminum ducts, supply installation testing and balancing of all grilles registers and diffusers, in accordance with these specifications and the general arrangement shown on the Drawings.

2 DUCT MATERIALS

All ducts shall be fabricated from galvanized steel sheets / aluminum sheets of the following thickness as indicated in Schedule of Quantities.

<table>
<thead>
<tr>
<th>Type of Duct</th>
<th>G S S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular ducts up to 75 cm</td>
<td>24 gage</td>
</tr>
<tr>
<td>Rectangular ducts 76 to 150 cm</td>
<td>22 gage</td>
</tr>
<tr>
<td>And all round ducts.</td>
<td></td>
</tr>
<tr>
<td>Rectangular ducts 151 to 225 cm</td>
<td>20 gage</td>
</tr>
<tr>
<td>Rectangular ducts greater than 225 cm</td>
<td>18 gage</td>
</tr>
</tbody>
</table>
1. Sheet metal ducts shall be fabricated out of galvanized steel sheets. Fabrication of ducts shall be through well conditioned Triplex lockformer or multiple lock formers, conforming to relevant BIS Codes. Sheets used shall be produced by Hot Dip Process and galvanizing shall be Class VII - Light Coating of zinc, Nominal 180 gm /Sq m surface area.

2. Samples of sheet from each lot selected at random by Owner’s site representative shall be subject to approval & gotten tested for thickness and zinc coating at contractor’s expenses.

3. All ducts shall be fabricated and installed in workmanlike manner, generally conforming to relevant BIS Codes. Round exposed ducts shall be die-formed for achieving perfect circle configuration.

   a. Ducts so identified on the Drawings shall be acoustically lined and insulated from outside as described in the section “Insulation” and as indicated in Schedule of Quantities. Duct dimensions shown on Drawings are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in Schedule of Quantities.

   b. Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made air tight.

   c. All exposed ducts up to 60 cm width within conditioned spaces shall have slip joints - or flanged joints. The internal ends of slip joints shall be in the direction of air flow. Ducts and accessories within ceiling spaces, visible from air conditioned areas shall be provided with two coats of mat black finish paint.

   d. Changes in dimensions and shape of ducts shall be gradual. Air-turns (Vanases) shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

   e. Ducts shall be fabricated as per details shown on Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

   f. All sheet metal connection, partitions and plenums required to confine the flow of air to and through the filters and fans shall be constructed of 18 gage GSS / 16 gauge aluminum, thoroughly stiffened with 25 mm x 25 mm x 3 mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Doors shall be not less than 45 cm x 45 cm in size.

   g. Plenums shall be panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside.

   h. Self adhesive rubber lining minimum 5 mm thick instead of felt shall be used between duct flanges and between duct and duct supports in all ducting installation.

4. All ducts shall be installed generally as per tender Drawings, and in strict accordance with approved shop drawings to be prepared by the Contractor.

   a. The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these Specifications and Drawings. The work shall meet with the approval of Owner’s site representative in all its parts and details.

   b. All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in
the building, whether or not the same are shown on the Drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and conduits, the ducts shall be transformed, divided or curved to one side (the required area being maintained) all as per the site requirements.

c. If a duct cannot be run as shown on the Drawings, the Contractor shall install the duct between the required points by any path available, in accordance with other services and as per approval of Owner’s site representative.

d. All duct work shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angle/channel under ducts at no greater than 2 metre centre. All vertical duct work shall be supported by structural members on each floor slab. Duct supports may be through galvanised steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods and angles/channels shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats.

e. Ducting over furred ceiling shall be supported from the slab above, or from beams, after obtaining approval of Owner’s site representative. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other Contractor’s work in the building.

Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick TF quality expanded polystyrene around the duct and totally covered with fire sealant such as fire barrier mortar for complete sealing.

h. All ducts shall be totally free from vibration under all conditions of operation. Whenever duct work is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of flame retardant, water proof, silicon rubber impregnated flexible connection at least 10 cm long securely bonded and flange bolted on both sides. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

j. Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top.

Dampers
a. Dampers: All duct dampers shall be opposed blade louver dampers of robust 16 G GSS construction and tight fitting. The design, method of handling and control shall be suitable for the location and service required.

b. Dampers shall be provided with suitable links levers and quadrants as required for their proper operation. Control or setting device shall be made robust, easily operable and accessible through suitable access door in the duct. Every damper shall have an indicating device clearly showing the damper position at all times.

c. Dampers shall be placed in ducts at every branch supply or return air duct connection, whether or not indicated on the Drawings, for the proper volume control and balancing of the air distribution system.

Fire & Smoke Dampers
a. All supply and return air ducts at AHU room crossings and at all floor crossings shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating as per UL555/1995 tested by CBRI. These shall be of multi-leaf type and provided with Spring Return electrical actuator having its own thermal trip for ambient air temperature outside the duct
and air temperature inside the duct. Actuator shall have Form fit type of mounting, metal enclosure and guaranteed long life span.

b. Fire damper blades and outer frames shall be of 16G galvanized steel construction fitted with 18 gage extended sleeves on both sides. The damper blade shall be pivoted on both ends using chrome plated spindles in self lubricated bronze bushes. Stop seals shall be provided on top and bottom of the damper housing made of 16G galvanized sheets steel. For preventing smoke leakage metallic compression seals will be provided.

c. The electric actuator shall be energized either upon receiving a signal from smoke detector installed in AHU room supply air duct / return air duct or temperature sensor. The fire damper shall also close upon sensing temperature rise in supply air ducts thru the electronic temperature sensor.

d. Each damper shall be provided with its own control panel, mounted on the wall and suitable for 240 VAC supply. This control panel shall be suitable for spring return actuator and shall have at least the following features:

- Potential free contacts for AHU fan ON/ off and remote alarm indication.
- Accept signal from external smoke / fire detection system for tripping the electrical actuator.
- Test and reset facility.
- Indicating lights / contacts to indicate the following status:
  - Power Supply On
  - Alarm
  - Damper open and close position.

e. Actuators shall be mounted on the sleeve by the damper supplier in his shop and shall furnish test certificate for satisfactory operation of each Motor Operated Damper in conjunction with its control panel. Control panel shall be wall mounted type.

f. It shall be HVAC Contractor’s responsibility to co-ordinate with the Fire Alarm System Contractor for correctly hooking up the Motor Operated Damper to Fire Detection / Fire Management System. All necessary materials for hooking up shall be supplied and installed by HVAC Contractor under close co-ordination with the fire protection system contractor.

g. HVAC Contractor shall demonstrate the testing of all Dampers and its control panel after necessary hook up with the fire protection / fire management system is carried out by energizing all the smoke detectors with the help of smoke.

h. HVAC Contractor shall provide Fire retardant cables wherever required for satisfactory operation and control of the Damper.

j. HVAC Contractor shall strictly follow the instructions of the Damper Supplier or avail his services at site before carrying out testing at site.

k. Fire/smoke damper shall be provided with factory fitted sleeves; however, access doors shall be provided in the ducts
within AHU room in accordance with the manufacturer’s recommendations.

1. The Contractor shall also furnish to the Owner, the necessary additional spare actuators and temperature sensor (a minimum of 5% of the total number installed) at the time of commissioning of the installation.

**Fire Dampers**

a. Whenever a supply/return duct crosses from one fire zone to another, it shall be provided with approved fire damper of at least 1½ hour fire rating as per UL555/1995 tested by CBRI. This shall be curtain type fire damper.

b. Fire damper blades shall be one piece folded high strength 16 gage galvanized steel construction. In normal position, these blades shall be gathered and stacked at the frame head providing maximum air passage and preventing passing air currents from creating noise or chatter. The blades shall be held in position through fusible link of temp 70°C.

c. In case of fire, the intrinsic energy of the folded blades shall be utilized to close the opening. The thrust of the suddenly released tension shall instantly drive the blades down and keep it down without the use of springs, weights or other devices subject to failure.

d. Fire damper sleeves and access doors shall be provided within the duct in accordance with the manufacturer’s recommendation.

e. The contractor shall also furnish to the Owner, the necessary additional fusible links (spares), as recommended by the manufacturer, at the time of commissioning of the installation.

**Supply And Return Air Grilles**

Supply & return air registers shall be of either steel or aluminum sections as specified in schedule of quantities. Steel construction registers shall have primer coat finish whereas extruded aluminum Grilles shall be either Anodized or Powder Coated as specified in Schedule of Quantities. These registers shall have individually adjustable louvers both horizontal and vertical. Supply air Grilles shall be provided with key operated opposed blade extruded aluminum volume control damper anodized in matt black shade.

The Grilles shall be suitable for fixing arrangement having concealed screws as approved by Architect. Linear continuous supply return air register shall be extruded aluminum construction with fixed horizontal bars at 15 Deg. inclination & flange on both sides only (none on top & bottom). The thickness of the fixed bar louvers shall be minimum 5.5 mm in front and 3.8 mm in rear with rounded edges. Flanges on the two sides shall be 20 mm/30 mm wide as approved by Architect. The grilles shall be suitable for concealed fixing. Volume control dampers of extruded aluminum anodized in black color shall be provided in supply air duct collars. For fan coil units horizontal fixed bar grilles as described above shall be provided with flanges on four sides, and the core shall be suitable for clip fixing, permitting its removal without disturbing the flanges.

a. All Grilles shall be selected in consultation with the Architect. Different spaces shall require horizontal or vertical face bars, and different width of margin frames. These shall be procured only after obtaining written approval from Architect for each type of register.

b. All Grilles shall have a soft continuous rubber/foam gasket between the periphery of the register and the surface on which it has to be mounted. The effective area of the registers for air flow shall not be less than 66 percent of gross face area.

c. Grilles / Registers specified with individually adjustable bars shall have adjustable pattern as each grille bar shall be
pivot able to provide pattern with 0 to +45 degree horizontal arc and up to 30 degree deflection downwards. Bars shall hold deflection settings under all conditions of velocity and pressure.

d. Bar longer than 45 cm shall be reinforced by set-back vertical members of approved thickness.

e. All volume control dampers shall be anodized aluminum in mat black shade.

f. In case of continuous grilles/diffusers, dummy grilles shall be blanked-off using GI sheet duly painted black.

g. All square/rectangular diffusers, slot diffusers to have insulated plenum installed above dampers from OEM factory & not to be constructed at site.

Supply And Return Air Diffusers
Supply and return air diffusers shall be as shown on the Drawings and indicated in Schedule of Quantities. Mild steel diffusers/dampers shall be factory coated with rust-resistant primer. Aluminum diffusers shall be powder coated & made from extruded aluminum section as specified in schedule of quantities.

a. Rectangular Diffusers shall be steel/extruded aluminum construction, square & rectangular diffusers with flush fixed pattern for different spaces as per schedule of quantities. These shall be selected in consultation with the Architect. These shall be procured only after obtaining written approval from Architect for each type of diffuser.

b. Supply air diffusers shall be equipped with fixed air distribution grids, removable key-operated volume control dampers, and anti-smudge rings as required in specific applications, and as per requirements of schedule of quantities. All extruded aluminum diffusers shall be provided with removable central core and concealed key operation for volume control damper.

c. Linear Diffuser shall be extruded aluminum construction with removable core, one or two way blow type. Supply air diffusers shall be provided with volume control/balancing dampers within the supply air collar. Diffusers for different spaces shall be selected in consultation with the Architect, and provided as per requirements of schedule of quantities. All diffusers shall have volume control dampers of extruded aluminum construction anodized in mat black shade.

d. Slot Diffuser shall be extruded aluminum construction multisport type with air pattern controller provided in each slot. Supply air diffusers shall be provided with Hit & Miss volume control dampers in each slot of the supply air diffusers. Diffusers for different spaces shall be selected in consultation with the Architect and provided as per requirement of Schedule of Quantities.

Measurements For Ducting
Unless otherwise specified, measurements for ducting for the project shall be on the basis of centre-line measurements described herewith:

a. Duct Work shall be measured on the basis of external surface area of ducts. Duct measurements shall be taken before application of the insulation. The external surface area shall be calculated by measuring the perimeter comprising overall width and depth, including the corner joints, in the centre of each duct section, multiplying with the overall length from flange face to flange face of each duct section and adding up areas of all duct sections. Plenums shall also be measured in similar manner.

For tapered rectangular ducts, the average width and depth shall be considered for perimeter, whereas for tapered
circular ducts, the diameter of the section midway between large and small diameter shall be adopted, the length of tapered duct section shall be the centre line distance between the flanges of the duct section.

For special pieces like bends, tees, reducers, branches and collars, mode of measurement shall be identical to that described above using the length along the centre line.

The quoted unit rate for external surface of ducts shall include all wastage allowances, flanges and gaskets for joints, nuts and bolts, hangers and angles with double nuts for supports, rubber strip 3 mm thick between duct and support, vibration isolator suspension where specified or required, inspection chamber / access panel, splitter damper with quadrant and lever for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the Specifications. These accessories shall NOT be separately measured nor paid for.

b. Special Items for Air Distribution shall be measured by the cross-section area perpendicular to air flow, as identified herewith:

i. Grilles and registers - width multiplied by height, excluding flanges. Volume control dampers shall form part of the unit rate for registers and shall not be separately accounted.

ii. Diffusers - cross section area for air flow at discharge area, excluding flanges. Volume control dampers shall form part of unit rate for supply air diffusers and shall not be separately accounted.

iii. Linear diffusers - shall be measured by cross-sectional areas and shall exclude flanges for mounting of linear diffusers. The supply air plenum for linear diffusers shall be measured with ducting as described earlier.

iv. Fire dampers - shall be measured by their cross-sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary collars and flanges for mounting, inspection pieces with access door, electrical actuators and panel. No special allowance shall be payable for extension of cross section outside the air stream.

v. Flexible connection - shall be measured by their cross-sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary mounting arrangement, flanges, nuts and bolts and treated-for-fire requisite length of canvas cloth.

vi. Kitchen Hoods - shall be measured by their cross-sectional area at the capture point of fumes, parallel to the surface of kitchen equipment. Quoted rates shall include the grease filters, provision for hood light, suspension arrangement for the hood, profile to direct the air to ventilation ducts and provision for removable drip tray.

**Testing And Balancing**

After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks by visual inspection as per BIS standards.

The entire air distribution system shall be balanced using an anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less/excess than 5 percent in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval, and four copies of the approved balance report shall be provided with completion documents.

**CO2 Sensors with exhaust fan**
The scope includes CO2 Sensor mounted in Return air path of the exhaust system synchronized with Vane Axial type exhaust Fan with associated controls & Accessories. All associated items herein to be supplied, delivered, installed, commissioned, tested and handed over.

Provide specialist’s agencies representative’s services including coordination and supervision in start up and testing.

The Co2 Sensor controller shall be of communicable type, and work on NO/NC potential free signals.

The Sensor shall complete with be built in type software and hardware to adjust the desirable levels of CO2 to suit the operation.

Testing
The entire air distribution system shall be balanced to supply the air quantities as required in various zones and rooms to maintain the specified room conditions. The final balancing of air quantity through each grille or diffuser shall be recorded and submitted to the Consultants for approval.

6. ELECTRICAL INSTALLATION

Scope
Scope of this section comprises the supply and installation of all electrical equipment such as motors, motor control centres, starters, cables, interlocks, etc. as required.

Codes, Standards and Statutory Regulations
Codes, standards and statutory regulations to be used for design and constructions are given below. In general all equipment, material as well as design and constructions shall be in accordance with the latest issues of Indian and relevant standards currently in force. The installation shall be carried out in accordance with the Indian Electricity Act and Rules.

Electric Supply System/Rated Voltage
415 volts, 3 phase, 4 wire, 50 Hz with solidly grounded neutral.

Variation in electric supply under which motor shall be operated continuously without any adverse effect will be as follows:
   a) Voltage : +/- 5%
   b) Frequency : +/- 5% variation
   c) Any combination of voltage and frequency.

Equipment and Materials
All equipment shall be as per specifications, and/or drawings supplied along with the tender documents. Equipment/materials shall be suitable for local climatic conditions as specified in the tender.

All equipment shall be of robust construction. Enclosure of equipment shall be dust, damp and vermin proof. Equipment for outdoor installation shall have weather proof enclosures requiring no further protection by the purchaser.
Approval
The Contractor shall be responsible for obtaining approval of drawings from statutory/local authority as required.

Motor Control Centre
Motor control centre shall consist of incoming switch fuse units/isolator and a starter mounted inside the wall or floor mounting type cubicle made out 2 mm thick MS sheet. Anti corrosion and phosphatising treatment shall be given to the sheets by a standard 5 tank/7 tank process.

All feeders shall be provided with two position (on-off) isolators, load break and quick make and break type. All isolators shall be suitable for front of board operation. Isolators for motor feeders shall preferably be of the ‘motor duty’ type i.e. capable of interrupting the locked rotor current of induction motors, which will be 6/8 times the full load current.

Isolators shall be interlocked with door to prevent opening or closing of the door in the closed (‘ON’) position of the isolator, in case of compartmental type of feeders. All live terminals on the isolators shall be adequately shrouded to prevent accidental contact and danger to the personnel.

Caution name plate “CAUTION LIVE TERMINALS” shall be provided at all points where the terminals are likely to remain live and isolation if possible only at remote ends e.g. Incoming Terminals of Incomer.

Fuses & Fuse Fittings
All fuses shall be of the non-deteriorating, high rupturing capacity, link, mounted in suitable fuse carriers or fuse bases.

Contactors
1. Contactors shall be magnetic, air break type, generally in accordance with BS 775/IS 2959.

2. All contactors in power circuits of motor starters or other feeders shall be adequately rated for the duty required and operating conditions. Minimum rating shall, however, not be less than 16 amps.

3. Contactor coils shall preferably be of draw out type for easy replacement. Coil voltage shall be 220V AC. Contactor coils shall operate satisfactorily between 110% and 85% of the nominal coil voltage. Drop off voltage for AC coils shall be between 80% and 45% of the nominal voltage.

4. Making and breaking capacities of the contactors shall be suitable for AC2 and AC3 categories of duty as per IS 2959 unless the contactors are required for special duty such as inching or plugging duty or capacitor duty, in which case, they will be suitably rerated.

5. Each contactor shall be provided with 4 normally open and 4 normally closed auxiliary contacts or as required by the control scheme. If necessary, auxiliary relays or contactors may be provided to obtain necessary number of auxiliary contacts. Auxiliary contacts shall preferably be convertible from NO to NC and vice versa.

Protective Devices
All feeders shall be protected by appropriate protective devices such as fused, combined bimetallic thermal overload and single phasing preventer relays.

Single phasing preventer relays (SPPRS) shall operate on the principle of unbalanced currents due to single phasing. BMR’s and SPPRs shall preferably have a change over contact which can be converted from hand reset to self reset and vice versa and used for contactor control as well as alarm/indication.
Current transformer, when specified, shall be of bar primary, ring type or wound type, and in accordance with IS 2705 or BS 2046 or BS 81. Class and ratio of CTs shall be specified. VA burden of CTs shall be suitable for the load burden.

Ammeters (144 square) voltmeters, PF meters, Run Hour meters and Kilowatt Hour meters shall be provided and shall be of industrial grade accuracy, suitable for flush mounting and in accordance with IS 1248. Suitable selector switches shall be provided in conjunction with ammeters and voltmeters.

Indicating Neon lamps used shall be of low voltage, low burden type with series resistor to increase lamp life and to protect equipment from short circuits caused by broken filaments. Lamp covers shall be provided with interchangeable colored lenses of Perspex or equivalent unbreakable materials. Lenses should not get discolored in course of time, due to the heat generated by the lamps. Name plates showing the condition indicated by the lamp shall be affixed near to the lamps.

Rating of terminal blocks for power and control circuits shall be at least 30 Amps and 15 Amps respectively. Terminals in control circuits shall be suitable for receiving one conductor per terminals of specified sizes. Terminals for power circuits shall be designed for receiving aluminum conductors and shall be screw clamp type or equal. Terminals for control circuit shall be suitable for receiving copper conductors. Star/Lock/Shake proof or Spring Washers shall be provided to prevent sparking due to vibrations. Special terminals with copper strips mounted on insulating supports may be provided for large cables. Where terminals, suitable extension bars with off-set may be provided.

Location of controls for motor starters or other feeders shall be specified. Normally one 'stop' push button with stay-put feature (lockable) and one reset push button for hand resetting of BMR shall be provided on the door of the compartment. Colors used for push buttons shall be as follows:

Stop push button - Red  
Start push button - Green  
Reset push button - Black

(Note: In case 'Stop', and 'Reset' are combined, only red colors will be used.) Name plates indicating the function of the push button shall be affixed near to the push buttons.

**Wiring**

Internal wiring of MCCs for power and control shall be carried out with copper conductor PVC insulated cables of PVC covered copper/ aluminum tapes.

Wiring of components mounted on doors shall be carried out with single strand 2.5 sq. mm copper conductor flexible cables. Wires and cables shall be neatly arranged and bunched together with suitable clamps made of insulating material. Wire harnesses shall be adequately supported along the MCC metal work.

Identification ferrules or tags shall be attached to each wire at each point connection.

Sizes of conductors for power wiring shall be determined by the manufacturers on the basis of full load current under specified conditions, protective fuse rating and appropriate rating factors as applicable. Minimum size of conductor shall be 2.5 sq. mm Minimum size of conductor for control wiring shall be 1.5 sq. mm.

The following color code shall be used for determining the colors of wires used for internal wiring. Manufacturer shall obtain specific approval of the purchases, if this color coding cannot be observed for any reason whatsoever:
Earth - Green
Neutral - Black
230V, A.C. phase - Red/Yellow/Blue,
To neutral - Black

All wiring shall be carried out in accordance with approval and certified panel wiring diagrams. Vendor shall check all wiring from point to point for correctness. All wires shall be numbered and the numbers shall be indicated on the relevant drawings.

Earthling
All metal work of the MCC and non-current carrying metallic parts of the equipment in the MCC shall be securely bonded together by adequate means e.g. use of earthling washer for bolted connections or tapped holes for mechanical connections. One copper earth bus running through the entire length of the MCC shall be provided preferably along with the terminal chambers. Size of the earth bus shall be such as to withstand phase to earth or 2 phases to earth short circuit for one second. The minimum size of the busbar shall be 25 x 3 mm. The terminals complete with hardware and cable sockets shall be provided on the earth bus for connection to external system.

Name Plates and Labels
1. One name plate giving designation of the MCC shall be affixed prominently on to the MCC. (Details of designation will be given). Each feeder shall also be labeled giving following details:
   i) Feeder No.
   ii) Feeder Designation (Eqpt.Ref.No. etc.)
   iii) Description
   iv) Rating (HP/KW/Amps)

2. All components whether mounted inside the MCC or on the door shall be permanently and clearly labeled with their reference number and/or letter or their function (rating of fuse shall form part of the fuse designation).

3. Labels for feeder designation shall be of laminated plastic or rear engraved Perspex with white letters on black background.

4. Labels for feeder designation shall be fixed on the doors on respective feeders with chrome-plated self tapping screws. Designation labels shall be identical in size to permit interchanging if required later.

Miscellaneous
All hardware used shall be plated or passivated to resist corrosion. Type of plating or passivation shall be subject to the approval of the Consultant. All fixing screws shall preferably be raised head type.

Drawings
1. Contractor shall furnish the following to the Consultant for his approval before commencement of fabrication:
   a. General Arrangement Drawing showing overall dimensions, arrangement of feeders, foundation plan, positions of cables entries, weight of MCC and sections in which MCC will be dispatched.
   b. Single Line Diagram for the MCC showing rating of various components used for all feeders complete with feeder
numbers, designations, descriptions, ratings, etc.

c. Schematic and panel wiring diagrams for all feeders.

d. Terminal plan for MCC, showing feeder numbers, terminal numbers and terminal markings.

1. After the final approval, six prints and one clear film reproducible of each of the above drawings shall be furnished.

2. The Contractor shall note that he shall bear full responsibility for any error, discrepancies, omissions, etc. in the drawings irrespective of whether such drawings have been approved or not. Approval of drawings shall not relieve the Contractor of his liability to complete the work in accordance with the specifications and other conditions of contract nor shall it exonerate the vendor from any of his guarantees.

Testing and Inspection

1. The following tests shall be carried out on the Motor Control Centres after completion of all work:

   i) All power and control circuits for MCCs shall be tested for insulation resistance with a 500 volt megger, before and after the high voltage test.

   ii) High voltage test shall be carried out on all power and control circuits at 2000 volts A.C. voltage applied for one minute.

   iii) Low voltage continuity test on all power circuits shall be carried out from busbars to the outgoing terminals of each feeder with switches and contactors in closed position.

   iv) All control circuits and operations of equipment for all feeders shall be checked with only control supply made available to ensure satisfactory operation of all equipment such as push buttons, BMR reset, indicating lamps, timing relays, etc. All contactor coils shall be checked for presence of humming or chattering. Special requirements for various feeders indicated in the purchase data sheets shall also be checked.

   v) Earth continuity test shall be carried out with a low voltage supply of not more than 6 volts, between various non-current carrying metallic parts of equipment, steel work, etc. and the earth bus provided in the MCC.

   vi) Operation of all instruments and meters provided on the MCC shall be checked.

2. All the tests listed above shall be carried out in the presence of Owner's representative, during final inspection. Contractor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests.

3. Contractor shall give a notice of not less than two weeks for inspection and testing by the Owner's representative.

Electric Motors

Rating & Duty

1. Rating of the motors shall be as indicated in the Schedule of Equipment. Where the equipment supplied needs a higher rated motor, the Contractor shall clearly point out and motors shall be offered accordingly.
2. All motors shall be rated for continuous duty at maximum output.

3. Rated voltage for three phase motors shall be 415 volts.

**Design Features**

1. Motor body shall be of close grained cast iron construction and shall be provided with lifting hooks or eye bolts. The motor along with the fan and half coupling shall be dynamically balanced.

2. Fan provided for fan cooled motor shall be non-directional type.

**Enclosure/Protections**

1. Enclosure for motors shall be totally enclosed fan cooled (TEFC) unless otherwise specified - SPDP motors shall be used only where the desired output is not obtainable in a TEFC frame.

2. All outdoor motors shall be TEFC weather proof type.

3. Degree of protection for all motors shall be IP 44 as per IS 491.

4. Two earthing terminals comprising terminals studs, two plain washers, one spring washer and nut shall be provided on opposite sides of the frame. Studs shall be suitable to receive appropriate size of earth conductor.

**Bearings**

All motors shall have ball and/or roller bearings with limit lubricators.

**Terminal Box**

1. Terminal box shall be of ample size, suitable for termination of aluminum conductor cables (with cable sockets) which may be substantially derated for conditions of installation.

2. Motor terminals shall be of stud type, substantially designed and well insulated from the frame. Each terminal shall be complete with two flat washers one lock nut.

3. Number of terminals shall be as given below:

4. Squirrel Cage Motors upto 3.7 Kw - 3 Nos.

Squirrel Cage Motors upto 3.7 Kw 
(with tinned copper links for delta connection) - 3 Nos.

Slip Ring Motors - 3 Nos.

5. Terminal boxes of all motors shall be rotatable in steps of 90 degrees, without disturbing the motor winding connections to the terminal block. Separate terminal box shall be provided for connections to anti-condensation heaters in case of motors about 50 HP. If heater terminals are provided in the main terminal box, then insulating barrier shall be provided between them with caution name plate affixed on the terminal box. "CAUTION - LIVE HEATER TERMINALS."
6. Separate terminal boxes for starter and motor leads to be provided for slip ring motors. Where it is not feasible, an approved type of insulating barrier to be provided.

**Temperature Rise**
The temperature rise of motors when tested in accordance with IS 325 shall not exceed the limits specified therein.

**Starting of Motors**
1. All squirrel cage motors shall be suitable for full voltage starting. Motors of 10 HP and above will generally be started with star/delta or auto transformer starters which, in addition to protective devices, shall be provided with single phasing preventer.

2. Starting current at full voltage of slip ring motors shall be limited by the rotor resistance starter. Motor manufacturer shall furnish appropriate value of external resistance required to limit the starting current as well as to obtain the required torque. However, starting current with slip rings shorted shall not exceed 600% of full load current. Starting current of squirrel cage motors with full voltage starting shall not exceed 600% of the full load current with tolerance specified in IS 325.

3. Starting torque of squirrel cage motor started on full voltage shall not be less than 200% of the full load torque. Pull out torque of motors shall not be less than 200% of the full load torque.

**Insulation**
1. All motors shall have Class 'D/F' insulation unless the ambient temperature or other conditions necessitate another class of insulation.

All materials used in the construction of motors shall be non-hygroscopic.

**Painting**
All motors shall be painted in an approved manner using two priming coats and two finish coats. The final color shall be to the Owner's requirements.

**Performance Particulars**
1. Following performance particulars for all motors to be furnished well in advance before finalizing orders for motors:
   a) Make
   b) Type
   c) Enclosure
   d) Class of Insulation
   e) Temperature Rise above 40 Deg.C ambient
   f) Rated Output
   g) Speed
h) No load current
i) Full load current
j) Locked rotor current
k) Starting torque (DOL)
l) Efficiency at full load, 3/4 load, 1/2 load
m) Power factor at full load, 3/4 load, 1/2 load
n) Details of rating for space heater
o) Max. Size of aluminum conductor cable which could be connected to motor
p) Rotor current at rated output
q) Value of rotor resistance for different torque values

MV Distribution Boards

Construction
1. The salient features of constructions panels shall be as follows:

2. Sheet Steel - 2 mm thick for frames, cable gland plates and equipment mounting plates and 1.6 mm thick for front and rear doors and covers

3. Welded construction, with shipping section bolted together. All such joints to gasketted. Lifting lugs to be provided.

4. The cubicles shall be totally dust and vermin proof conforming to IP 54 of IS 2147.

5. All doors to be hinged type except busbar chamber covers which shall be bolted type. The panel shall be of flush front design, suitable for access from front and rear.

6. The construction shall be such as to facilitate easy extension at both ends.

7. The design shall be such as to have individual feeders in separate compartments, with proper barriers between adjacent feeders, busbar chamber and cable box chambers.

Painting
1. All sheet steel work shall be properly cleaned and degreased. Rust and scale shall be removed by picking and phosphatising. After phosphatising, two coats of primer shall be applied followed by two coats of finishing synthetic enamel paint of approved shade as per IS-5. The painting shall be stove enameled.
Air Circuit Breakers
1. The circuit breaker shall be air-break, horizontal draw-out feature shall show 3 positions viz. SERVICE, TEST and ISOLATED. These positions along with 'OPEN' and 'CLOSE' positions shall be visibly marked.

2. All positions shall have provisions for locking. The ACB shall have shutter assembly and arc-chutes and mechanical trip features.

3. The ACB shall have 6 NO + 6 NC auxiliary contacts rated at 10 A, 240 V, AC.

4. ‘RED’ and ‘GREEN’ indicating lamps shall be provided on the cubicle.

5. The ACB door shall not have any lamps or instruments. All such accessories shall be mounted on a separate compartment.

6. The ACB shall have proper interlocks such that it cannot be 'plugged in or out' 'SERVICE' position, if the breaker is in 'ON' condition. It shall not be possible to operate as circuit breaker unless it is properly engaged in any of the three positions.

7. The ACB shall have series CI operated over-current and short-circuit releases with facilities to mount the under voltage and shunt-trip releases.

8. The operating mechanism shall be independent, manual spring charged stored energy type. The mechanism shall ensure quick-break, quick make action and the ACB shall be trip-free in operation.

Air Break Switches
1. The air break switches shall be of AC23, (heavy) duty, quick make-quick break, fault- make type as per IS 4047. The contacts shall be silver plated.

2. The switches shall be capable of withstanding the mechanical and thermal stresses produced by overloads and short circuits.

3. All switches of all ratings shall have inter-locks with the compartment doors. Switches of 250 A and above shall be lockable in the ‘OFF’ position. All live parts shall be shrouded. It shall be possible to intention- ally defeat the interlocks if required.

4. ‘RED’ indicating lamp shall be provided for 'ON' indication.

Fuses:
All fuses shall be of HRC cartridge fuse-link type having a certified rupturing capacity of not less than 46 KA at 415 volts AC. The HRC fuses shall conform to IS 9224 1979. All fuses shall have visible indication to indicate 'Blown' condition.

HRC Fuse Carriers
1. The HRC fuse carriers/bases shall be of high grade phenolic moldings. The contacts shall be silver plated and the contact blocks shall be suitable to receive the rated conductors of aluminum.

2. The fuse carriers shall have an aperture to view the conditions of HRC fuse mounted inside.

Contactors
1. The motor starter contactors shall be of the electro-magnetic, double-break, non-gravity type rated for uninterrupted duty suitable for operation under AC 3 utilization category as per IS 2959. The contacts shall be silver plated.

2. 2 NO and 2 NC auxiliary contacts shall be included.

3. The operating coils shall have Class ‘E’ insulation of wire and shall be suitable for operation of any specified control supply system.

**Thermal Overload Relays**

1. The thermal overload relays shall be 3 element, positive action, ambient temperature compensated with a time lag and adjustable settings. The setting range shall be selected in accordance with the ratings of the motor.

2. The relay shall be self-reset/hand reset as called for in the case of hand-reset, the reset button shall be fixed on the compartment door.

3. The relay shall have at least one ‘NC’ and one ‘NO’ or one change-over contact.

**Moulded Case Circuit Breakers**

1. The moulded case circuit breakers, MCCBs shall be provided where certified. The MCCBs shall conform to the latest applicable IS 2516-1977.

2. For AC Circuits the MCCBs shall be triple pole construction and shall have independent manual opening and closing mechanism. The mechanism shall be quick-make and quick-break type and the breakers shall be trip-free in operation. The ‘ON’, ‘OFF’ and ‘TRIP’ mechanism shall be clearly indicated.

3. Bolted type neutral link to be provided with TP MCCB.

4. It shall be possible to mount accessories on the MCCBs like shunt-trip and under voltage release, alarm contacts, etc.

5. The MCCBs shall have thermal/static trip devices.

6. The MCCBs shall have rupturing capacities as specified in BOQ/Single Line Diagram.

**Miniature Circuit Breakers**

1. The MCBs shall be of single pole, double pole, triple pole or four pole as required. The MCBs shall be of magnetic type with a maximum rupturing capacity of 9 KA at 415 V.

**Current Transformers**

1. The CTs shall be of dry type and shall have short-time withstand rating equal to the short-time withstand rating of the associated switchgear for 1 second.

2. The measuring instrument CTs shall be of 15 VA, minimum accuracy class 1.0 and an instrument safety factor of 5.

3. The protection relay CTs shall be of 15 VA, minimum accuracy class 5P and an accuracy limit factor of 10.

**Indicating Instruments and Meters**
1. Electrical indicating instruments shall be 72 mm/96 mm/144 mm square size, suitable for flush mounting.

2. The zero adjustment shall be done from outside the cover.

3. The dials to be parallax free with black numerals on a white dial.

**Indicating Lamps**

1. Indicating lamps shall be of the filament type and of low watt consumption, provided with series resistors and HRC fuse link for promotion.

2. The lens shall be easily replaceable from the front.

**Control and Selector Switches**

1. The control and selector switches shall be of rotary type, adequately rated for the application but with a minimum rating of 10 Amps at 240 V AC and 1 Amp at 220 V DC. The plates shall have clear position markings.

2. The control switches shall have pistol grip handles spring return to normal. The selector switches shall have oval knobs and shall be contact stay-put type.

**Push Buttons**

1. The push buttons shall be of the momentary contact, push to actuate rated for 10 A at 240 V AC and 1 A 220 V DC. The ‘START’ push buttons shall be green and shrouded. The ‘STOP’ push button shall be red and unshrouded. All other push buttons shall be black.

2. The elements shall be enclosed with 1 ‘NO’ and 1 ‘NC’ contacts. It should be possible to add on easily extra elements to increase the number of ‘NO’ and ‘NC’ contacts.

**Main and Auxiliary Buses**

1. The busbars shall be of high conductivity aluminum alloy of E91E grade. The busbar shall be of uniform cross-section throughout the length of the panels.

2. All main and auxiliary busbars shall be insulated with sleeves. The sleeves shall be of high dielectric strength, non-corrosive and of phase and neutral colors.

3. The busbars shall be supported on cast epoxy/resin/DMC/Fiberglass insulators and the spacing of the supports shall be such as to withstand the stresses of the short circuit currents. The busbar spacing’s shall be adequate for 3 phase voltage upto 600 V.

4. The busbar shall be a chosen for specific current ratings with a minimum density of 1 amp for sq.mm area.

**Internal Wiring**

1. All internal wiring shall be carried out with 1100 V/650 V grades PVC insulated, stranded conductor copper wires. The minimum size of wires shall be 2.5 sq.mm copper and for CTs also 2.5 sq.mm copper.

2. All individual control and CTs wiring shall be labeled with engraved identifications ferrules, yellow in color with black letters.
3. All wiring shall be terminated on stud type terminal blocks through crimping sockets. No more than one connection shall be made on any one terminal block.

4. All spare auxiliary contacts of contactors and relays shall be wired to control terminal blocks.

**Terminal Blocks**
1. Terminal blocks for power and control shall be of reputed make stud type, with washers, nuts and lock-nuts. All adjacent terminals shall have insulating barriers.

2. All power terminal blocks shall be appropriately rated for current with a minimum of 30 Amps. The control terminal blocks shall be rated for a minimum of 10 A and suitable for at least 2 conductors each of 2.5 sq.mm.

3. All sets of power and control power terminal blocks shall be identified with engraved plastic labels, black background and white letters.

**Identification Labels**
1. All labels shall be black plastic with white engravings of letters of minimum 6 mm sizes.

**Earthing**
1. All switchgears shall have continuous run of earth busbar. The size and materials of the earth bus-bar shall be specified.

**Tariff Advisory Committee and CPRI Tested**
The switchgear shall be approved by the Tariff Advisory Committee (for Fire Insurance) and CPRI tested for short circuit test and enclosure test.

**Tests**
1. High Voltage test at 2.5 KV.


3. Insulation Resistance Test with 1000 V Meggar.

4. Operational Test.

5. Three Sets of Test Certificates to be submitted.

**Drawings**
1. Three sets of general arrangement drawings and wiring diagrams of all types of feeders shall be submitted.

**Control Stations**
1. Control station shall be of cast iron or cast aluminum enclosures, consisting of "START" and "STOP" push buttons and shall have stayput feature of twist unlock type.

**Cable and Accessories**
1. All cables shall be heavy duty PVC insulated armoured and PVC sheathed of 1.1 KV grade. Aluminum conductor
cables shall be used for power and copper conductor cables shall be used for control wiring.

**Glands**

1. Glands used for termination shall be compression type. Cable glands shall be with single/double seal and cone and clamp for armoured clamping.

2. For safe and indoor areas, glands with single seal and for outdoor installation and hazardous areas, gland with double seals will be used. For use in corrosive areas, glands shall be coated with rust proofing lacquer after installation and provided with PVC hoods.

3. Cable lugs shall be of Dowell or equivalent approved make, suitable for connection of aluminum conductor cables. The cable lugs shall be of tinned copper and of soldering type for solid conductor cables. For stranded conductor cables, crimping type, tinned copper cable lugs shall be used.

**Conduits and Accessories**

Conduits wherever used with prior approval of the Contractor shall be of GI heavy gauge/black enamelled/PVC. All accessories, such as junction boxes, shall be duly approved by competent authorities. Terminal blocks of adequate rating are to be provided in the junction boxes.

**Saddles**

Saddles to be used for cleating cables or conduits shall be fabricated from MS or aluminum strips or any other approved material and shall be painted and dried before installation with chemical works type paint.

**Cable Tags and Identification Ferrules**

Cable tags and identification ferrules provided on cable cores/wires shall be of PVC/plastic. Cable tags shall be provided at every 15 meters and at all bends or change in routes.

**Structural Steel**

This shall include MS angles, channels, flats, etc. required for fabrication of cable trays, local supports for cables, control stations, etc. All steel sections shall be new and conform to IS 226.

**Miscellaneous Materials**

These shall include solders, fluxes, adhesive insulating tapes, PVC sleeves, petroleum conducting jelly, etc.

**Earthing Material**

Copper strips or wires of suitable sections shall be used for earthing in accordance with IS 3403.

All 3 phase 415 Volts equipment shall be earthed at two points and all single phase equipment at one point.

**Painting**

All metal work and metal parts of the MCC shall be thoroughly cleaned to remove ruse, scale grease or any other matter. Suitable anti-corrosion treat- ment such as phosphatising shall be given to the metal work. All exposed surfaces of the metal work shall then be given a priming coat of zinc chromate or equivalent and finished with two coats of paint of specified shade.

**Drawing**

Contractor shall submit 3 copies of control of schematic wiring diagram for refrigeration unit showing all protections and interlocks for Consultant's review and approval. After the final approval six prints and one clear reproducible of each
drawing shall be furnished.

**Installation**

**Motor Control Centres**
Motor Control Centres shall be installed on welded construction channel framework. Framework shall be properly grouted by means of foundation bolts or anchor fasteners.

**Cable Laying**
As far as possible, cable shall be run in built up trenches and on walls/ceiling. Cables shall be dressed and clamped to the wall/ceiling by means of GI strap saddles of minimum 3 mm thickness. Cables shall be kept away from wall ceiling by saddle bars of at least 6 mm thickness. Cables running in built-up trenches shall also be properly clamped when cable run is on side walls of trench. Cable entry into the building shall be through suitable GI pipes or hume pipes or trenches. All cable entry openings into the buildings shall be properly sealed with cold setting, PVC compound or other approved materials.

**Cable Termination**
PVC cables shall be terminated with compression type glands. For outdoor installation double seal compression glands shall be used. All cables shall be connected by means of suitable crimping type cable lugs. All connections shall be secure and vibration proof. All contact surface shall be coated with petroleum conducting jelly before connections are made.

**Earthing**
All metallic framework and non-current carrying metallic parts and enclosures of electrical equipment such as MCCB, motors, control station, etc. shall be bonded to one another and earthed by means of two separate earth conductors and connected to the plant earthing system.

**Motors**
All motors shall be installed on a common foundation with the driver equipment coupled through flexible couplings or belt drive.

Leveling and alignment of motor and driven equipment to be carried out as per IS 900 to avoid undue strain on motors.

Insulation resistance of motor shall be measured before commissioning. In no case insulation resistance should be less than one meg ohm. If it is less than one meg ohm motor should be dried out as per procedure laid on IS 900. Pre-commissioning mechanical checks shall be carried out as per IS 900.

Cable termination and earthing of motors shall be carried out by Electrical Contractor.

On commissioning of motor, any defects like excess current, bearings getting hot, undue vibration or noise etc. are observed, it will have to be made good by the Contractor without any extra cost.

**Testing and Commissioning**

**Operation Test**
1. Energise only control circuits and carry out closing and tripping operations. (Where AC supply derived from main supply is used for operation, the switchgear bus may be energised). Check tripping of circuit breakers by manual operation of protective relay contacts. Check operation of mechanical closing and tripping devices. Check lockout
conditions for closing of circuit breakers by simulating the required conditions. Check control, indications, sequence interlocks and alarms.

2. Polarity and connections of instrument transformers check for correctness of CT and PT connections provided with transformer. Check electrical continuity of secondary circuits with ELV tester. Adjust spacing of arcing horns/rod gaps.

3. Check operation of instruments, meters, relays and tripping of circuit breakers by primary/secondary injection as specified. This test will be carried out only if specifically called for by Contract Documents.

4. Check continuity of power circuits and earth continuity of all non-current carrying metallic parts with a low voltage (6V or less) continuity tester.

5. Carry out IIV test on power and control circuits if specifically called for in Contract Documents.

**Motors**
Check equipment for free movement of rotor and play, lubrication and for any other mechanical defects and direction of rotation.

Check commutators, slip rings, brushes, brush-holders, etc. for satisfactory conditions. Insulation test of motors between winding and ground. Use 500 V megger for MV motors and 1000 V megger for HV motors. Check electrical continuity with ELV tester.

**Control Cables**
Carrying insulation test on all power and control circuits. Check all equipment for satisfactory operation and correct wiring.

**Wiring**

1. Insulation test between phases, between each phase and neutral and between each phase/neutral and ground.

2. DC High Voltage Test on HV Cables in accordance with the relevant Indian Standards and Code of Practice. This test shall be carried out on cables, installed in final position and all joints and terminations have been made. The cables, however, may not be connected to the equipment so that the equipment may not be subjected to the test voltage.

3. In case of lighting wiring, insulation test shall be carried out on lighting feeders with branch circuits open. Branch circuits shall be tested separately with lampholders, plug receptacles and lighting fittings in position but without lamps. In case of lighting circuits with lamp ballasts and glow starters insulation resistance may be measured between phase and ground only.

4. In case of directly buried cables, insulation resistance of cables shall be measured before and after the back filling. Test all receptacles for correct phase sequence.

**Earthing System**
Continuity test for earth continuity conductors with ELV tester.

**Operation test**
After successful completion of the above tests, operational tests shall be carried out by the Contractor for checking the connections done by him and satisfactory operation of all the equipment supplied by him. This test shall be carried out
initially without energising power circuits. Various control conditions shall be simulated for the purpose of this test. Any defects detected during the tests such as blown fuses, damage to devices, shall be rectified by the Contractors, free of cost.

**TECHNICAL DATA FOR ALL MAJOR EQUIPEMENTS**

Technical data shall be furnished as follows:

1.0 **VRV / VRF OR Dx Refrigeration system**
   a) Manufacturer
   b) Type of Unit -
   c) Overall dimensions
   d) Operating weight
   e) Approx. noise level (db)
   f) Capacity in HP – IDU
   g) Total static pressure (ins W.G.)

**Cooling Coils:**
   a) Coil fin material
   b) Fin thickness
   c) No. of fins
   d) No. of rows deep
   e) Tube dia. (ins)

**Filter Section:**
   a) Pressure drop through filter when new (ins. WG)
   b) Efficiency

2.0 **Ventilation & Exhaust Fans:**
   a) Manufacturer
   b) Fan discharge position
   c) Speed (rpm)
   d) Fan dia.
   e) C.F.M.
   f) Motor (hp) and make
   g) Static pressure (ins. WG)
   h) Balance (static and/or dynamic)

3.0 **Insulation:**
   a) Manufacturer
b) Material  
c) “K” value  

4.0 **Controls:**  
a) Manufacturer  
b) Thermostat type  
c) Humidistat type  
d) Damper motor type  

5.0 **Electric Motors:**  
a) Manufacturer  
b) Type of motor and frame reference  
c) Rated output (hp)  
d) Range of working voltage  
e) No. of phases and phase connections  
f) Nominal frequency  

**SPECIFICATIONS - H.V.A.C. WORK**  
g) Rated speed (rpm)  
h) Rated current (amps)  
i) Class of insulation  
j) Temperature rise with cooling air at 40 Deg.C  
k) Efficiency and power factor  

6.0 **Switch Gear:**  
A. Circuit Breakers  
a) Manufacturer  
b) Symmetrical short circuit at 415 volts  
c) Normal current (amps)  
d) O/L and E/F trip  

**MODE OF MEASUREMENT**  

1 **Piping**  
Measurement of all piping shall be on the basis of centre-line measurement described below:  

Piping shall be measured in units of length along the centre line of installed pipes including all pipe fittings, wastage, allowances, Pipe / Puf supports, flanges, gaskets, nuts & bolts, unions, bands, elbows, tees, concentric / eccentric reducers, inspection pieces, expansion loops, etc. The above accessories shall be measured as part of piping length along the centre line of installed pipes, and no special multiples of pipe lengths for accessories shall be permitted.

Only refnet joints as Tees and Y joints shall be paid separately as they are not part of refrigerant piping.

All painting, labling, shall form part of the cost of equipment, piping, etc. No separate payment shall be admissible.
2 **Sheet Metal Work**

Sheet metal work shall be on the basis of measurement described below:

All sheet metal ducting complete with ducts, supports, hangers, vibration isolation pads, turning vanes, girth angles, flanges, gaskets & food grade sealant, access panels erected in position shall be measured externally on the finished areas of the ducting and paid per unit area.

All manual control / splitter dampers sections with operating linkages, supporting, etc shall be included in the duct area. The price of dampers shall have to be included in the sheet metal installed ducting price. No separate payment shall be admissible.

Tapered rectangular ducts width & depth shall be considered for perimeter whereas for tapered circular ducts the diameter of the section midway between large & small diameter shall be adopted. The length of tapered duct section shall be the centre line distance between the flanges of the duct section.

The quoted unit rate for external surface of ducts shall include all wastage, allowances where specified or required, inspection chambers / access panel with splitter damper and quadrant / lever for position indication and other accessories. These accessories shall not be separately measured nor paid for.

The measurement of ducts shall be carried out before applying insulation.

3 **Insulation**

Area of external duct insulation finished as per specification shall be calculated on the basis of finished duct area before insulation including flanges (including double cover of min 200 mm over flanges), dampers, VAV boxes, installation accessories, etc and paid at unit area.

Acoustic insulation shall be calculated on basis of external duct size including nut bolt, flanges, aluminum perforated sheets, all supporting accessories and paid for per unit area.

Room acoustic insulation shall be calculated on basis of finished installed area including all accessories and paid for per unit area.

All pipe insulation shall be linear length through fittings and valves. Pipe shall be measured along the length of the pipe including flanges, coupling, gaskets and all installation accessories. It is to be clearly noted that for the insulation measurement all these accessories including cladding, valves, orifice plates & strainer shall be considered strictly by linear measurement along the centre line of pipes and no special rates shall be applicable for insulation of any accessories, fixtures or fittings whatsoever.

4 **Grilles / Diffusers**

Air distribution items shall be measured by the cross section area.

Grilles / Diffusers, Linear diffusers (to be measured in Rmt / nos.) fire dampers, shall be measured based on cross-sectional area including flanges, mounting arrangements, nuts & bolts (inspection pieces / door with electrical actuator & panel for fire damper), aluminum opposed blade volume control dampers shall form part of supply air diffusers and shall not be separately measured nor paid for. Flexible insulated fibre glass ducting to be measured in Rmt, same as sheet metal ducting with all accessories. Curvature / Round grilles to be also measured in Rmt.
5 **Electrical installation**

Cost of motors, electrical panel, power and control wiring with GI tray, safeties, installation, all accessories shall be included in the cost of driven equipment (wherever indicated with equipment). Power cables, cable tray & earthing to be measured in Rmt. Cable terminations in double compression gland to be measured in numbers.

Panel shall be counted as no. of units. Quoted rates shall include as lumpsum and not measurable length. All internal & power wiring, earthing connections from the control panel to the starter and motor / control wiring for interlocking, safety controls, control wiring for remote start / stop and automation as well as indication as per the specifications. The quoted rate of panel shall also include all accessories, switchgears, contactors indicating lights, meters, Safety controls & interlocking, VFDs as per the specification and schedule of quantities.

The unit rate for cables include the cost of cables & clamps & GI tray installation, testing & commissioning, cable markers, ceiling support. No payment shall be made for left out and installed cut cable pieces.

The rates for cable termination work shall include the cost of copper / aluminum lugs of suitable size, Ni-Cd double compression cable glands etc.

Rubber mat shall be provided in front to cover the full length of all panels, where back space is provided for working from the rear of the panel, Rubber mat shall also be provided to cover the full length of panel. Cost to be included in panel cost.

6 **General Notes**

i) Cost of painting, galvanization of all equipment, piping, etc. shall be included in each item, and no extra shall be paid.

ii) MS Structural work except mentioned above to be measured in Kgs.
TECHNICAL SPECIFICATION FOR FIRE ALARM SYSTEM
(Life Safety System)

1.1 General
This performance specification provides the minimum requirements for the Fire Alarm System (Life Safety System). The system shall include, but not limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system to include but not limited to the following functions:

- Smoke and fire detection.
- Sprinkler suppression system monitoring
- Off-premise notification.
- Smoke control.
- Releasing Service
- One-way voice communication notification system.
- Two-way voice communication system.

1.2 Materials & Equipment
All equipment and components shall be the approved manufacturer's current model. The materials, appliances, equipment and devices shall be listed by a nationally recognized approvals agency like UL864/FM/EN54 for use as part of a protected premises protective signaling (fire alarm) system and smoke control system. The authorized representative of the manufacturer, to be designated as the contractor, shall be responsible for the satisfactory installation of the complete system. The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building owner. All specified operational features must be met without exception. All equipment and components shall be the manufacturer's current model. The contractor shall be responsible for the satisfactory installation of the complete system. All control panel assemblies and connected field appliances shall be provided by the same system supplier, and shall be designed and tested to ensure that the system operates as specified. The system shall utilize electronically addressable, microprocessor-based detectors as described in this specification. The equipment to be supplied will be considered only if it meets all sections of the performance specification.

The supplier shall submit a point-by-point statement of compliance for all sections in this specification. The statement of compliance shall consist of a list of all paragraphs within these sections. Where the proposed system complies fully with the paragraph, as written, placing the word "comply" opposite the paragraph number shall indicate such. Where the proposed system does not comply with the paragraph as written, and the supplier feels the proposed system will accomplish the intent of the paragraph, a full description of the function as well as a full narrative description of how its proposal will meet its intent shall be provided. Any submission that does not include a point-by-point statement of compliance as described herein shall be disqualified. Where a full description is not provided, it shall be assumed that the proposed system does not comply. The Contractor shall furnish all labor, services and materials necessary to furnish and install a complete, functional fire alarm system (System). The System shall comply in respects with all pertinent codes, rules, regulations and laws of the Authority, and local jurisdiction. The System shall comply in all respects with the requirements of the specifications, manufacturer's recommendations and Underwriters Laboratories (UL) listings.

It is further intended that upon completion of this work, the Owner/Consultant be provided with:
a. Complete information and drawings describing and depicting the entire system(s) as installed, including all information necessary for maintaining, troubleshooting, and/or expanding the system(s) at a future date.

b. Complete documentation of system(s) testing.

c. Certification that the entire system(s)

1.3 CODES & LISTING:
The equipment and installation shall comply with the current and latest edition of the following codes and listing:

A) National Fire Protection Association (NFPA) - USA:

NFPA 13 Sprinkler Systems
NFPA 16 Foam/Water Deluge and Spray Systems
NFPA 17 Dry Chemical Extinguishing Systems
NFPA 17A Wet Chemical Extinguishing Systems
NFPA 2001 Clean Agent Extinguishing Systems
NFPA 72 National Fire Alarm Code
NFPA 76 Telecommunication Facilities
NFPA 318 Clean Room Applications
NFPA 101 Life Safety Code
NFPA 90A Air conditioning & ventilation system

Listed

B) Underwriters Laboratories Inc. (UL) - USA:

UL 268 Smoke Detectors for Fire Protective Signaling Systems
UL 864 Control Units for Fire Protective Signaling Systems 9th Edition
UL 268A Smoke Detectors for Duct Applications
UL 521 Heat Detectors for Fire Protective Signaling Systems
UL 464 Audible Signaling Appliances
UL 38 Manually Actuated Signaling Boxes
UL 346 Water flow Indicators for Fire Protective Signaling Systems
UL 1971 Visual Notification Appliances
UL 228 Door Holders
UL 1481 Power Supply for fire protective signaling system.
UL 1711 Amplifiers for Fire Protective Signaling Systems.
UL 1635 Digital Alarm Communicator System Units
Factory Mutual (FM) Approval


UL 9th Schedule Certification
International Standards Organization (ISO)
ISO-9000
ISO-9001
European Union (EU)
EMC Directive 89/336/ EEC
Electromagnetic Compatibility Requirements
C) LOCAL CODES
   NATIONAL BUILDING CODES
   IS-2189

D) European Standards
   EN54

E) German Standards
   VDS

2.0 Panel Components & Functions
The control panel(s) shall be a multi-processor based networked system designed specifically for fire, one-way and two-way emergency audio communications, smoke control, extinguishing agent releasing system if necessitated, with integration modules for BMS or any third party control/annunciation. The control panel shall be UL/FM listed. The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified. The control panel(s) operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

The network of control panels shall include the following features:
- Ability to download all network applications and firmware from the configuration computer from a single location on the system.
- Provide electronic addressing of analog/addressable devices.
- Provide an operator interface control/display that shall annunciate, command and control system functions.
- Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
- Provide a discrete system control switch provided for reset, alarm silence, panel silence, drill switch, previous message switch, next message switch and details switch.
- Provide system reports that provide detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a printer.
- Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
- Provide an authorized operator to perform test functions within the installed system.

The control panel shall contain a standby power supply that automatically supplies electrical energy to the system upon primary power supply failure. The system shall include a charging circuit to automatically maintain the electrical charge of the battery.

2.1 Operator's Interface
The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the building. Standard LED annunciator may be combined in common enclosures provided that the groups of LED's comprising each of the required annunciator are separated from one another (Detection, Supervisory, Status, and Security) and clearly labeled. A minimum 640-character LCD display shall be part of the
main control panel for easy alarm reading and understanding. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.

The annunciator shall contain the following system status indicators:

- LCD character Backlit Liquid Crystal Display
- System Normal Indicator
- System Common Alarm Indicator
- System Common Trouble Indicator
- System Common Supervisory Indicator
- System Ground Fault Indicator
- System Common Security Indicator

2.2. Audio

The system shall be capable of delivering multi-channel audio messages simultaneously over copper and/or fiber media. All audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits. The one-way emergency audio control shall provide control switches to direct paging messages as follows:

"All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.

"Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.

"Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.

"Page to Balance Building" to direct page messages to the areas in the facility NOT receiving either the evacuation area or alert area messages.

"Page by Phone" switch to select the firefighters telephone system as the source for paging.

The system shall be capable of delivering multiple audio messages simultaneously over copper and/or fiber media. All audio messages and live pages shall originate at the one-way emergency audio control unit. The one-way emergency audio control unit shall store pre-recorded audio messages digitally. These messages shall automatically direct to various areas in a facility under program control. The system shall support remote panels with zoned amplifiers to receive, amplify and distribute messages through speakers over supervised circuits. The two-way voice communications control unit shall provide two-way communications between remotely located phones and the command center. The control unit shall provide the ability to individually select and display each two-way voice communication circuit support up to five (5) remote telephones in simultaneous two-way voice communications.

**Audio Amplifiers (Multi-Channel)**

Provide as minimum one twenty (20) watt (Maximum capacity should be decided as per site requirement). audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for
amplification. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000 Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall include a dedicated, selectable 25/70 Vrms output. Provide a standby audio amplifier that will automatically sense the failure of a primary amplifier, and replace the function of the failed amplifier.

2.4 Power Supply
System power supply(s) shall provide multiple powers limited 24 VDC output circuits as required by the panel. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.

All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciated as battery trouble and identify the specific power supply affected. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.

All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of NFPA 72 - The AC power circuit shall be installed in raceway. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each control panel the disconnect serves.

Power supply for all input & output devices to be driven from main Fire Alarm Panel.

2.8 Field Mounted System Components

Intelligent Smoke Detectors: (Optional)

General
The smoke detector shall have inbuilt microprocessor and shall be capable of taking an independent alarm decision. Minimum to 125 intelligent smoke detectors should connect to one loop. Each intelligent addressable smoke detector's sensitivity shall be capable of being programmed electronically from Control Panel without any extra tools as most sensitive, more sensitive, normal, less sensitive or least sensitive. In addition to the five sensitivity levels the detector shall provide a pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value. The detector should continue to give TRUE alarms even if the loop controller on the main panel fails.

An alternate alarm sensitivity level shall be provided for each detector, which can be set to any of the five (5) sensitivity settings manually or automatically using a time of day event. In addition to the five alternate sensitivity levels the detector shall provide an alternate pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alternate alarm sensitivity value The detector shall be able to differentiate between a long drift above the pre-alarm threshold and fast rise above the threshold.

The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be compared against its reference value. The detector shall provide a maintenance alert signal
that 75% to 99% compensation has been used. The detector shall provide a dirty fault signal that 100% or greater compensation has been used.

The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.

**Multi-sensor Photo Thermal Detector : (Optionals)**
The multi-sensor or multi-tech smoke detector which will have both photoelectric as well as thermal detection elements shall have inbuilt microprocessor, and shall be capable of taking an independent alarm decision. The scattering of smoke particles shall activate the photo sensor. Each intelligent addressable smoke detector's sensitivity shall be capable of being programmed electronically from Control Panel without any extra tools as: most sensitive, more sensitive, normal, less sensitive or least sensitive. In addition to the five sensitivity levels the detector shall provide a pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value. The detector should continue to give TRUE alarms even if the loop controller on the main panel fails.. Alarm condition shall be based upon the combined input from the photoelectric, and thermal detection elements. Each detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.

**4D/Laser Photo Detector. (Optionals)**
The 4D/Laser/equivalent detector shall have the ability to have the sensitivity of 0.08 OBS/FT or better. The detector shall have inbuilt microprocessor and shall be capable of taking an independent alarm decision. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. Each detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.

**INTELLEGETH THERMAL DETECTOR: (Optionals)**
The heat detector shall have a thermal sensing element /circuit. The detector shall have inbuilt microprocessor, not microcontroller and shall be capable of taking an independent alarm decision. Detectors shall be rated at 15°F (9°C) per minute rate-of-rise and 135°F (57°C) fixed temperature. The detector shall be capable of being addressed electronically from control panel without any extra tool.

**ADDRESSABLE BEAM DETECTOR: (Optionals)**
The addressable optical beam detector or projected beam smoke detector shall be used for detection in large volumes and double heights. The set shall consist of a transmitter, receiver and control electronics. The transmitter shall project a modulated infrared light beam to the receiver. If there is smoke in the beam path, the receiver signal shall be reduced by the value proportional to the density of the smoke. If the signal is reduced to a level between the obscuration threshold and 93% for 8-10 seconds, the fire alarm relay shall be activated. The alarm obscuration threshold shall be set at 25%, 35% or 50% obscuration depending on the application. The typical coverage shall be equal or more than 100 m x 15.25 m.

SMOKE DETECTOR – PHOTOELECTRIC

The detectors shall be use the photo electric (light scattering) principal to measure smoke density. Provide analog/addressable photoelectric smoke detectors at the locations shown on the drawings. The detector shall have the ability to set the sensitivity and alarm verification of each of the individual detectors on the circuit. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient environmental thresholds approximately six times an hour. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.

Detector Bases:
The bases shall be easy to install and mount and shall be of standard type or isolator base type or sounder base type. The sounder base shall be used where local or group alarm signaling is required. The sounder base emits an audible alarm when there is fire. The base shall, contain no electronics and support all series detector types.

3.0 Manual Stations

The fire alarm station shall be of polycarbonate construction and incorporate an internal toggle switch. A locked test feature shall be provided. The station shall be finished in red with silver "PULL IN CASE OF FIRE" lettering.

3.1 Sounders/Hooters with Strobe

Electronic sounders shall operate on 24 VDC nominal. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device and shall be flush or surface mounted as shown on plans. They shall produce broad band directional sound to guide occupants to safe exists even in complete darkness. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria: The maximum pulse duration shall be 2/10 of one second. Equivalent alternate type will be also acceptable

Strobes shall provide synchronized flash output, that shall be switch selectable for output values of 15cd, 30cd, 75cd & 110cd. Wattage and candela settings shall be visible with the cover installed. When the cover is installed, no mounting hardware shall be visible. In and out screw terminals shall be provided for all wiring.

3.2 Intelligent Modules

The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes, which can be retrieved for troubleshooting assistance. Input and output circuit
wiring shall be supervised for open and ground faults.

**Control Relay Module:**
The Control Relay Module shall provide one form "C" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.

**Dual Input Module:**
The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The dual input module shall support the following circuit types:
- Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
- Normally-Open Alarm Delayed Latching (Water flow Switches)
- Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
- Normally-Open Active Latching (Supervisory, Tamper Switches)

**Dual Input Signal Module:**
The Dual Input (Dual Riser Select) Signal Module shall provide a means to selectively connect one of two (2) signaling circuit power risers to one (1) supervised output circuit. The dual input signal module shall support the following operation:

- Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25 Vrms @ 50w or 70 Vrms @ 35w of Audio)

**Isolator Module:**
Provide intelligent fault isolators modules. The Isolator Module shall be capable of isolating and removing a fault from a class A data circuit while allowing the remaining data loop to continue operating.

**Monitor Module:**
The Monitor Module shall be factory set to support one (1) supervised Class B Normally-Open Active Non-Latching Monitor circuit.

**Single Input Module:**
The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The single input module shall support the following circuit types:
- Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
- Normally-Open Alarm Delayed Latching (Water flow Switches)
- Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
- Normally-Open Active Latching (Supervisory, Tamper Switches)

**Single Input Signal Module:**
The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The single input signal module shall support the following operations:
- Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)
- Telephone Power Selector with Ring Tone (Fire Fighter's Telephone)
3.3 **Power Supply**

Standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for 24 hours and capable of operating the system for fifteen (15) minutes of evacuation alarm on all devices, operating at maximum load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.

3.5 **Sequence of Operations**

**General - Audio**

Upon alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler water flow, the following functions shall automatically occur:

The internal audible device shall sound at the control panel or command center.

Display the alarm event on the graphical workstation. The LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location and time/date. All system activity/events shall be documented on the system printer. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.

The following audio messages and actions shall occur simultaneously:

An evacuation message shall be sounded on fire floors (zones) immediately above and below (adjacent to) the fire floor (zone), on the floor in fire condition. It is the intent of this message to advise occupants hearing this message that they are near danger and should leave the building via the stairs (nearest exit) immediately.

Activate visual strobes on the fire floors (zones) immediately above and below (adjacent to) the fire floor (zone). The visual strobe shall continue to flash until the system has been reset. The visual strobe shall not stop operating when the "Alarm Silence" is pressed. An alert message shall be sounded on the remainder of building. It is the intent of this message to advise occupants to prepare for evacuation if necessary. An instructional message shall be sounded in the stairwells instructing occupants to move carefully and quickly down the stairs to exit the building and to exit to a safe floor if you encounter smoke in the stairwell.

An instructional message shall be sounded in the elevator cabs. It is the intent of this message to advise elevator occupants that an emergency exists, the elevator has been directed to the ground floor, and that occupants should quickly exit the building. An instructional message shall be sounded in the lobby. It is the intent of this message to advise lobby occupants to leave the lobby and clear the area for arriving firefighters. An instructional message shall be sounded in the concourses connected to the building's lobby. It is the intent of this message to prevent new entries into the lobby by advising occupants not to attempt to enter the lobby of the affected building.

Provide selective paging to each individual floor (zone). In addition to the message/channels detailed above, a dedicated page channel shall be capable of simultaneously providing live voice instructions without interrupting any of the messages listed above shall be provided.

Transmit signal to the building automation system.
Transmit signal to the central station with point identification.
Activate automatic smoke control sequences.
All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
All stairwell/exit doors shall unlock throughout the building.
All self-closing fire/smoke doors held open shall be released.
Direct the closed circuit TV cameras to the alarm event and start video recording.

**Supervisory Operation**
Upon supervisory activation of any sprinkler valve supervisory switch, fire pump off-normal, clean agent fire suppression system trouble, the following functions shall automatically occur:

The internal audible device shall sound at the control panel or command center.  
Display the event on the graphical workstation and display a pictorial image.

The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date. All system activity/events shall be documented on the system printer.

Any remote or local annunciator LCD/LED’s associated with the supervisory zone shall be illuminated. Transmit signal to the central station PC with point identification.

**Trouble Operation**
Upon activation of a trouble condition or signal from any device on the system, the following functions shall automatically occur:

The internal audible device shall sound at the control panel or command center.  
Display the event on the graphical workstation and display a pictorial image.

The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date. All system activity/events shall be documented on the system printer.

Any remote or local annunciator LCD/LED’s associated with the trouble zone shall be illuminated. Transmit signal to the central station PC with point identification.

**Monitor Activation**
Upon activation of any device connected to a monitor circuit, the following functions shall automatically occur:

The internal audible device shall sound at the control panel or command center.

Display the event on the graphical workstation and display a pictorial image.

The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.

All system activity/events shall be documented on the system printer.

Any remote or local annunciator LCD/LED’s associated with the status zone shall be illuminated.
4.0 Notification Appliance Circuits
All notification appliance circuits shall have a minimum circuit output rating of: 2 amps @ 24 vdc; 50 watts @ 25V audio, and 35 watts @ 70V audio. The notification circuits shall be power limited. Non-power limited circuits are not acceptable.

4.6 Training
The System Supplier shall schedule and present a minimum of 8 hours of documented formalized instruction for the building owner, detailing the proper operation of the installed System. The instruction shall be presented in an organized and professional manner by a person trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the Installation. The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

5.0 SYSTEM OPERATION – FUNCTIONAL SPECIFICATIONS AND PRODUCTS

5.1 General: The system shall be integrated into a comprehensive system, to provide the functional performance described as follows:

5.1.1 Fire Detection and Alarm System

5.1.1.1 The fire detection and alarm system shall monitor and display the activation of each device in the system, such as heat detector, smoke detector, manual break-glass unit, sprinkler water flow switch, sprinkler valve tamper switch, hose reel water flow switch and hose reel valve tamper switch or any other input device which may be required.

5.1.1.2 The system shall initiate output functions such as automatic alarm annunciation via speakers, fans shutdown, automatic notification to the Fire main control PC and activation of audible hooters/directional sounders/strobes.

5.1.1.3 The system shall be of the addressable intelligent type, completely supervised, such that a break in any wire (loop) shall not prevent any device from operating. The system shall be of the type such that each device connected to the system shall be provided with unique address and separately identified at the Main control panel (MCP).

5.1.4 The wiring shall be monitored against faults such as opens, shorts, earth’s or data transmission failure. Detection addressable loops, capable of handling minimum of 250 addressable points shall return to the control panel.

5.1.2 Emergency Paging And Voice Alarm

5.1.2.1 The system shall permit communication in the form of paging from the main control panel and telephone switchboard to any floor or group of floors simultaneously. The system shall be capable of manual operation or automatic operation initiated by the fire alarm system. Speakers shall be located as required to achieve acceptable audibility in all Communication addressable loops will be supervised and therefore return to the control panel.

5.2 Scope
5.2.1 The appropriate authorities shall approve the exact location.

5.2.2.2 Photoelectric type smoke detector shall be with integral microprocessor and shall be capable of taking an independent alarm decision. In case of the failure of the main loop controller the detector shall be capable of operating in standalone mode or degrade mode and continue to take decisions.

5.2.3 Heat detectors of the fixed temperature (57 deg.C) type or rate of rise of temperature type shall be used in areas environmentally unsuited for smoke detectors such as Kitchens, Valet Laundries, Emergency Generator rooms.

5.2.5 Break-glass stations (manual fire alarm stations) shall be located on the occupied side of the door to each exit stair and at intermediate locations as required (Maximum distance between pull stations shall not exceed 60 m).

5.3 System Operation

5.3.1 The system shall be arranged for categories of alarm inputs and provide output functions appropriate to each of the categories;

5.3.1.1 Supervisory Monitor input: The following inputs shall be considered supervisory monitoring functions:

5.3.2.1 Sprinkler system shut off valve tamper switch.

5.3.2.2 Removal of a smoke detector from its base.

5.3.2.4 Wiring faults.

5.3.3 Activation of a supervisory monitoring device shall provide the following indications:

5.3.3.1 The MCP and remote annunciators shall indicate an audible and visual “TROUBLE” condition. In addition, the “trouble alarm” shall be displayed on the graphic display unit for the type of alarm.

5.3.3.2 Printer shall print clear next message on the event log indication the device, which initiated a trouble alarm.

5.3.3.3 An alarm signal shall be automatically sent to the local control room as well as REMOTE control room if designed. This may be accomplished by means of a web server /Netcom/ digital dialer.

5.3.3.4 In case of fire all lift call and door buttons and signals shall become inoperative, lifts serving that floor shall be signaled to immediately return to the ground floor or as designated by the local Fire department and be held for the exclusive use of the Fire Brigade. Should such an alarm occur on the ground floor, the lifts shall be signaled to return to an alternate floor which is not in alarm.

5.3.3.5 Signals shall be sent directly to heating, ventilating and air conditioning fan motor controllers for status monitoring circuits to confirm the operation of the fan systems.

5.3.3.6 The details of the fan control sequence shall be as follows:

5.3.3.7 All fans serving the areas affected by the alarm condition shall shutdown.
5.3.3.8 Smoke extraction fan system shall have to be started

5.3.3.9 Stair pressurization fans shall be started.

5.4.1.1 Signals shall be transmitted to the paging system to display zone in alarm.

5.4.1.2 The printer shall print a clear text message on the event log printer. The printer shall print the device information indicating clearly in plain language which device is in alarm, the time, and the date associated with the alarm. The printer shall print all follow-up information regarding this alarm, such as acknowledge, reset etc.

5.4.1.3 All access control doors shall be released in case of fire condition shall allow for more than one floor at a time to be displayed.

**FAS Cables: (FRLS rated)**

2 x 1.5 sq mm annealed tinned copper (ATC) conductor PVC sheathed FRLS armoured Multi strand cables as per specifications given below;

i) **Cable Type**
   - Signal
   - Armored FRLS
   - Multistrand Conductors
   - Twisted pair

ii) **Conductor**
   - Conductor dia - 0.2mm
   - No. of Strands - 48
   - ATC
   - Resistance per Km. (Max. 25 Ohms)

iii) **Individual Insulation**
    - PVC Type as per IS - 5831
    - Insulation Thickness nominal: 0.6mm

iv) **Total Cores**
    - No. of Pairs 1 (One) laid in sequence
    - Colour code: Red

v) **Overall Sheath**
   - Thickness - 1.8mm
   - Material - PVC type as per IS - 5831
   - Outer dia - 10.5mm dia min
APPENDIX “A”

LIST OF APPROVED MAKE / MODEL
PREAMBLE:

1) All materials shall conform to relevant technical specifications of Volume – 2 of the Tender document. The materials shall be further subjected to tests in the recognized laboratories at the sole discretion of the Engineer-in-Charge and shall be at contractor’s cost.

2) Materials bearing appropriate IS marking and having valid licence for last 3 years shall be given preference while selecting for the work.

3) In case of materials which are not widely available with IS marking in the market but conform to the technical specifications mentioned in the Tender Documents, the same shall be procured from any of the manufacturer listed below after prior written approval of the EIC.

4) Reinforcement steel shall be procured from any vendors who have the license for at least last 5 years for manufacture of BIS or Tor allies, subject to prior written approval of the EIC. Steel samples of all the lots procured shall be subject to testing through recognized laboratories and shall be at contractor’s cost.

5) Cement for work shall have relevant IS marking and every lot shall be subject to tests in the recognized laboratories and shall be at contractor’s cost.

6) EIC can approve any other brand subject to verification of the adherence to the relevant technical specifications.

A. Electrical Work

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Details of Materials / Equipment</th>
<th>Manufacturer’s Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LT Panel and Motor Control Centre.</td>
<td>Sterling &amp; Wilson / Arrow Engineers / Abak / Shivam Electricals</td>
</tr>
<tr>
<td>2</td>
<td>Sandwiched Construction Busduct and Rising Mains</td>
<td>Control &amp; Switchgear / Intraco BKS (Marketed by Larsen &amp; Toubro) / Schneider Electric / Legrand</td>
</tr>
<tr>
<td>3</td>
<td>Final Distribution Board</td>
<td>Hager / Legrand</td>
</tr>
<tr>
<td>4</td>
<td>Motor Starter</td>
<td>L &amp; T / Schneider / Siemens</td>
</tr>
<tr>
<td>5</td>
<td>Air Circuit Breaker (3/4 Pole)</td>
<td>Larsen &amp; Toubro (U-Power) / Schneider Electric (Master Pact NW) / Siemens (3WL) / Legrand (DMX³)</td>
</tr>
<tr>
<td>6</td>
<td>Moulded Case Circuit Breaker (MCCB)</td>
<td>Schneider Electric / Larsen &amp; Toubro / Siemens / Legrand / Hager</td>
</tr>
<tr>
<td>7</td>
<td>Miniature Circuit Breakers (MCB)</td>
<td>Legrand / Havels/ MK</td>
</tr>
<tr>
<td>8</td>
<td>Residual Current Circuit Breaker (RCCB)</td>
<td>Legrand / Havels/ MK</td>
</tr>
<tr>
<td>9</td>
<td>Change Over Switch</td>
<td>Havells / HPL – Socomec / Larsen &amp; Toubro / Cummins</td>
</tr>
<tr>
<td>10</td>
<td>Current Transformer (Epoxy Cast Resin)</td>
<td>Automatic Electric / Indcoil / Pragati</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Details of Materials / Equipment</td>
<td>Manufacturer’s Name</td>
</tr>
<tr>
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<td>------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Control Transformer/Potential Transformers</td>
<td>Automatic Electric / Indcoil / Pragati</td>
</tr>
<tr>
<td>12</td>
<td>Protection Relay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Numeric Type</td>
<td>Larsen &amp; Toubro / Siemens</td>
</tr>
<tr>
<td></td>
<td>b. Electromagnetic Type</td>
<td>Larsen &amp; Toubro</td>
</tr>
<tr>
<td>13</td>
<td>Indicating Lamps LED type and Push Button</td>
<td>Larsen &amp; Toubro (ESBEE) / Schneider Electric / Teknik</td>
</tr>
<tr>
<td>14</td>
<td>Overload relays with built in Single Phase preventer</td>
<td>Larsen &amp; Toubro / Schneider Electric / Siemens</td>
</tr>
<tr>
<td>15</td>
<td>a. Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED/ Display</td>
<td>L &amp; T / Schneider Electric (Conzerve) / Secure</td>
</tr>
<tr>
<td>16</td>
<td>PVC insulated XLPE aluminium / copper conductor armoured MV Cables upto 1100 V grade</td>
<td>Finolex / KEI / Havells / CCI</td>
</tr>
<tr>
<td>17</td>
<td>LT Jointing Kit / Termination</td>
<td>3M / Raychem / REPL</td>
</tr>
<tr>
<td>18</td>
<td>Cable Gland (Double Compression type)</td>
<td>Comet / Cosmos</td>
</tr>
<tr>
<td>19</td>
<td>Bimetallic Cable Lug</td>
<td>Comet / Cosmos / Dowell’s (Biller India)</td>
</tr>
<tr>
<td>20</td>
<td>PVC insulated copper conductor stranded flexible wires (FRLS) -</td>
<td>Finolex / R R Kabel / Havells</td>
</tr>
<tr>
<td>21</td>
<td>Conduit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Mettallic / GI Conduit (ISI approved)</td>
<td>AKG / BEC / Vimco</td>
</tr>
<tr>
<td></td>
<td>b. PVC Conduit &amp; Accessories (ISI approved)</td>
<td>Precision / Modi</td>
</tr>
<tr>
<td></td>
<td>c. Flexible GI Conduit</td>
<td>Flexicon / PLICA India Pvt. Ltd.</td>
</tr>
<tr>
<td>22</td>
<td>Switch &amp; Socket</td>
<td>Legrand ARTEOR / MK – Wrap around plus / Crabtree Verona</td>
</tr>
<tr>
<td>23</td>
<td>Terminal Blocks</td>
<td>Connect Well / Elmex</td>
</tr>
<tr>
<td>24</td>
<td>Industrial Socket</td>
<td>Legrand / Hager</td>
</tr>
<tr>
<td></td>
<td>a. Splash Proof</td>
<td>MDS Legrand / Schneider Electric</td>
</tr>
<tr>
<td></td>
<td>b. Metal Clad</td>
<td>HANSEL / MDS</td>
</tr>
<tr>
<td>25</td>
<td>Ceiling Fan</td>
<td>Crompton Greaves High Speed / Havells Pacer</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Details of Materials / Equipment</td>
<td>Manufacturer's Name</td>
</tr>
<tr>
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<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>26</td>
<td>Lighting Fixtures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Halogen / PL / Metal Halide / Fluorescent</td>
<td>Philips / Wipro</td>
</tr>
<tr>
<td></td>
<td>b. External Lighting Fixtures</td>
<td>Philips / Wipro</td>
</tr>
<tr>
<td></td>
<td>c. Aviation obstruction Lights (LED Types)</td>
<td>Actos / Bajaj / Binay</td>
</tr>
<tr>
<td></td>
<td>d. Electronic Ballast (To be selected as per fixture manufacturer)</td>
<td>Philips / Wipro</td>
</tr>
<tr>
<td></td>
<td>e. Occupancy Sensors</td>
<td>Philips / Wipro</td>
</tr>
<tr>
<td>27</td>
<td>Timer</td>
<td>Larsen &amp; Toubro / Schneider Electric</td>
</tr>
<tr>
<td></td>
<td>Hot-dip Galvanized</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Cable Trays (Factory Fabricated) / Raceways / GI Trunking</td>
<td>MK (raceway) / Asian Ancillary Corporation / Profab Engineer / OBO Bettermann</td>
</tr>
<tr>
<td>29</td>
<td>UPVC Wall trunking</td>
<td>MK / Legrand / OBO Bettermann</td>
</tr>
<tr>
<td>30</td>
<td>Lighting Poles (Polygonal GI poles)</td>
<td>Bajaj Electricals</td>
</tr>
<tr>
<td>31</td>
<td>Fire Sealant &amp; Fire Retardant Paint</td>
<td>3 M India Ltd. / HILTI</td>
</tr>
<tr>
<td>32</td>
<td>Standalone emergency light fixture</td>
<td>Legrand / PHILIPS</td>
</tr>
<tr>
<td>33</td>
<td>Power/Aux. Contactors</td>
<td>Larsen &amp; Toubro / Schneider Electric / Siemens</td>
</tr>
<tr>
<td>34</td>
<td>Motor Protection Circuit Breaker(MPCB)</td>
<td>Larsen &amp; Toubro / Schneider Electric / Siemens</td>
</tr>
<tr>
<td>35</td>
<td>Selector Switches</td>
<td>Kaycee / Salzer (Larsen &amp; Toubro)</td>
</tr>
<tr>
<td>36</td>
<td>Lighting Poles</td>
<td>Bombay Tubes and Poles / Bajaj Electricals / HOMDEC Lighting / Keselec / K-Lite</td>
</tr>
<tr>
<td>37</td>
<td>Fire Sealant &amp; Fire Retardant Paint</td>
<td>3 M India Ltd. / HILTI / OBO Bettermann / Promat</td>
</tr>
<tr>
<td>38</td>
<td>Lightning Protection System</td>
<td>ABB – Pulsar / Indelec / Nimbus</td>
</tr>
<tr>
<td>39</td>
<td>Lighting &amp; Surge Voltage Protection</td>
<td>ASCO / Hager (Marketed by L&amp;T) / Indelec / OBO Bettermann / Schneider Electric</td>
</tr>
<tr>
<td>40</td>
<td>HDPE underground cable duct</td>
<td>Rex Polyextrusion / Tirupati Plasomatics / Duraline</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Details of Materials / Equipment</td>
<td>Manufacturer’s Name</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>41</td>
<td>RCC Hume Pipes – NP2 Class</td>
<td>Dhere / K K / INDIAN HUME PIPE / Pranali</td>
</tr>
<tr>
<td>42</td>
<td>Welding Rod</td>
<td>Advani / Esab</td>
</tr>
<tr>
<td>43</td>
<td>Alarm Annunciator</td>
<td>Advani Oralikon / Larsen &amp; Toubro / Minilec</td>
</tr>
<tr>
<td>44</td>
<td>G. I. &amp; M.S. Pipe upto 200 MM Dia.</td>
<td>Jindal / Tata Steel</td>
</tr>
<tr>
<td>45</td>
<td>G. I. &amp; MS PIPES above 200 mm dia factory rolled</td>
<td>Jindal / SAIL</td>
</tr>
<tr>
<td>46</td>
<td>GI Pipe Fittings</td>
<td>Unik / Zoloto M</td>
</tr>
<tr>
<td>47</td>
<td>HRC Fuse &amp; Fuse fittings</td>
<td>L &amp; T / Siemens</td>
</tr>
<tr>
<td>48</td>
<td>Insulating Rubber Mats</td>
<td>Commercial Enterprises / DL Miller &amp; Co. Ltd. / Premier Polyfilm Ltd. / RMG Polyvinyl India Ltd.</td>
</tr>
</tbody>
</table>

**STRUCTURED CABLEING SYSTEM (VOICE / DATA)**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Details of Materials / Equipment</th>
<th>Manufacturer’s Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cat-6 Cable, Wires &amp; Fiber Optic Cable</td>
<td>Molex / Legrand / Systemax</td>
</tr>
<tr>
<td>2</td>
<td>Patch Cords, patch panels, cross connect, data outlet, LIUs, Pigtailed, Splice Holders</td>
<td>Molex / Legrand / Systemax</td>
</tr>
<tr>
<td>3</td>
<td>Main Distribution Frame for voice, Telephone Tag blocks</td>
<td>Krone / ITL</td>
</tr>
<tr>
<td>4</td>
<td>Telephone Armoured Cables</td>
<td>Finolex / ITL / Polycab</td>
</tr>
<tr>
<td>5</td>
<td>Data Switches, receiver , media converter</td>
<td>3-Com / CISCO / HP</td>
</tr>
<tr>
<td>6</td>
<td>Racks for Data Switches / Patch Panels</td>
<td>HCL / Rittal / Valrack / Legrand</td>
</tr>
</tbody>
</table>

**Note:**

- In case of LAN & Telephone works, all the passive components shall be of one make or else 100% compatibility shall be ensured. Required certification for compatibility from component manufacturer to be furnished on demand of Engineer-in-Charge
### B. Public Health Work

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Details of Materials / Equipment</th>
<th>Manufacturer's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vitreous chinaware water closet, Flush Tank, Wash Basin, Soap dish, Urinals, Toilet paper roll holder, Sink etc.</td>
<td>Parryware, Hindware, Cera, Neyser or approved eq.</td>
</tr>
<tr>
<td>2</td>
<td>CP brass fittings &amp; fixtures such as Bib tap, Stop cock, Pillar tap, waste coupling, Bottle Trap etc.</td>
<td>Kingston, Jaquar, GEM, L&amp;K, MARC, Parko Ess-Ess or approved eq.</td>
</tr>
<tr>
<td>3</td>
<td>Seat &amp; cover for EWC</td>
<td>Commander, Hindustan, Capri, Supreme or approved eq.</td>
</tr>
<tr>
<td>4</td>
<td>Jet Spray</td>
<td>Jaquar</td>
</tr>
<tr>
<td>5</td>
<td>WC Connectors</td>
<td>Prince / Supreme</td>
</tr>
<tr>
<td>6</td>
<td>Toilet Paper Holder</td>
<td>Jaquar</td>
</tr>
<tr>
<td>7</td>
<td>Glass, Mirror</td>
<td>Modi Guard, Saint Gobin, Float glass or appr. eq.</td>
</tr>
<tr>
<td>8</td>
<td>Stainless steel Sink</td>
<td>Nirali, Neelkanth, AMC, Jayna or approved eq.</td>
</tr>
<tr>
<td>9</td>
<td>Urinal Sensors</td>
<td>Jaquar</td>
</tr>
<tr>
<td>10</td>
<td>Floor Drain Fixture, Rain Water Outlets</td>
<td>ACO / GMGR / Geberit / Viega</td>
</tr>
<tr>
<td>11</td>
<td>G.I / M.S Pipes</td>
<td>ITC, TATA, Zenith, Ambika, Surya, Khandelwal, Jindal, Hissar / AST Pipes / Hitech / Swastik or approved eq.</td>
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<tr>
<td>12</td>
<td>G.I Malleable fittings</td>
<td>PEC, MJM, Unik, Zoloto, ‘R’/ Jain Sons / Kirti or approved eq.</td>
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<tr>
<td>13</td>
<td>C.P. Grating for Floor Trap</td>
<td>Chilly / GMGR / Neer</td>
</tr>
<tr>
<td>14</td>
<td>GM or copper alloy Gate / Peet / Globe / Check valve</td>
<td>Neta, Sant, Kingston, NEW, Leader, Zoloto, GG</td>
</tr>
<tr>
<td>15</td>
<td>Ball Valve</td>
<td>MBM, Sant, Techno, A.I ( JS ), Zoloto or approved eq.</td>
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<tr>
<td>16</td>
<td>GM / Forged Brass Ball Valves</td>
<td>CIM / Danfoss / Jayhiwa / Kitz / RB / Sant / Tiemme / TSB</td>
</tr>
<tr>
<td>17</td>
<td>Air Valve / Kinetic Air Valve</td>
<td>Durga, BSJShau, VKE, Sant, Hawa, IVC, Mayur, BJC</td>
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<tr>
<td>18</td>
<td>Water meter</td>
<td>Capston, Keycee, Paramount or approved eq.</td>
</tr>
<tr>
<td>19</td>
<td>Sluice valve / Foot valve ( swing &amp; lift type )</td>
<td>BSJ-Shau, Mayur, Upadhyay, Minoti, Effco, Kartar, KPM, IVC, Leader, Durga, Kirloskar.</td>
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<tr>
<td>20</td>
<td>C.I Water quality pipes</td>
<td>Electrosteel, KDUL, Kesoram or approved eq.</td>
</tr>
<tr>
<td>21</td>
<td>C.I Soil quality pipes</td>
<td>A-1, Neco, Rifco, SRIF or approved eq.</td>
</tr>
<tr>
<td>22</td>
<td>C.I Frame &amp; Cover</td>
<td>A-1, Neco, Rifco, SRIF, Kajeco or approved eq.</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Details of Materials / Equipment</td>
<td>Manufacturer's Name</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>23</td>
<td>S.W Pipe &amp; Gully Trap</td>
<td>Kashmira, Rajura, Girco, Perfect, C.I.or approved eq.</td>
</tr>
<tr>
<td>24</td>
<td>RCC Hume pipe</td>
<td>IHP, Pranali, Premier, Shreeji, Pragati, Usha, JSP or app. eq.</td>
</tr>
<tr>
<td>25</td>
<td>SFRC frame &amp; cover / gratings</td>
<td>Bharat, Shreeji, SS, KK or approved eq.</td>
</tr>
<tr>
<td>26</td>
<td>HDPE Pipe</td>
<td>Prince, Goutam, Duraline, Kimplas, Reliance or approved eq.</td>
</tr>
<tr>
<td>27</td>
<td>SS Pipes</td>
<td>Remi / Viega</td>
</tr>
<tr>
<td>28</td>
<td>SWR-PVC pipe &amp; fittings</td>
<td>Prince, Premium, Supreme, Finolex, Kissan, Perfect Potteries, JABALPUR or approved eq.</td>
</tr>
<tr>
<td>29</td>
<td>Water supply – PVC pipes &amp; fittings</td>
<td>Prince, Premium or approved eq.</td>
</tr>
<tr>
<td>30</td>
<td>Pig Lead</td>
<td>Hindustan Zinc</td>
</tr>
<tr>
<td>31</td>
<td>PVC flushing Cistern</td>
<td>Commander, Hindustan, Duralite or approved eq.</td>
</tr>
<tr>
<td>32</td>
<td>Pressure Gauge</td>
<td>Pie-big, Guru or approved eq.</td>
</tr>
<tr>
<td>33</td>
<td>Foot Valve ( Ball type )</td>
<td>Normex</td>
</tr>
<tr>
<td>34</td>
<td>SBR / EPDM Gaskets</td>
<td>Prabhat, Orient, Paul, Durable or approved eq.</td>
</tr>
<tr>
<td>35</td>
<td>C.I fittings / Specials</td>
<td>Kejriwal, Upadhyay, Orient, Durga or approved eq.</td>
</tr>
<tr>
<td>36</td>
<td>Flush Valves</td>
<td>Jaguar, Parko, Orient or approved eq.</td>
</tr>
<tr>
<td>37</td>
<td>Electronic flush Valve for Urinal</td>
<td>Cera, Parryware, Jaguar, Utech, Robo, Angus, Askon Engineers / Euronics / Toshi / UTEC System or approved eq.</td>
</tr>
<tr>
<td>38</td>
<td>Check Valve – WaferType</td>
<td>Advance / Danfoss / Kirloskar / Jayhiwa</td>
</tr>
<tr>
<td>39</td>
<td>Check Valve – Dual Plate</td>
<td>Advance / SKS</td>
</tr>
<tr>
<td>40</td>
<td>Check Valve Forged Screwed</td>
<td>CIM / Leader / RB / Sant / TBS / Zoloto</td>
</tr>
<tr>
<td>41</td>
<td>Check Valves ( slim type )</td>
<td>Zoloto, Intervafe or approved eq.</td>
</tr>
<tr>
<td>42</td>
<td>Butterfly Valve</td>
<td>Audco, C&amp;R, Intervafe, Keystone, IVC, Durga, Danfoss / Honeywell / Jayhiwa or approved eq.</td>
</tr>
<tr>
<td>43</td>
<td>Ball Valve ( 15 to 40 mm )</td>
<td>CIM, Sant or approved eq.</td>
</tr>
<tr>
<td>44</td>
<td>Pressure Reducing Valve</td>
<td>Fouress / Honeywell / RB / SKS / OR / Zoloto</td>
</tr>
<tr>
<td>45</td>
<td>Cockroach trap</td>
<td>Chilly</td>
</tr>
<tr>
<td>46</td>
<td>CI double flanged non-return valve</td>
<td>Kirloskar, IVC, Leader, or approved eq.</td>
</tr>
<tr>
<td>47</td>
<td>Cast Iron Pipes &amp; Fittings Manhole covers and frames</td>
<td>As per IS:3989 (Pipes &amp; Fittings)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kapilash</td>
</tr>
</tbody>
</table>
|         |                                                  | As per IS:1729 (Manhole covers and frames)                                          | Raj Iron Foundry Agra
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Details of Materials / Equipment</th>
<th>Manufacturer's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>D.I. Manhole Covers &amp; Frames</td>
<td>Kartar valves &amp; fittings</td>
</tr>
<tr>
<td>49</td>
<td>CILA fittings</td>
<td>Kartar valves &amp; fittings</td>
</tr>
<tr>
<td>50</td>
<td>Suspended Manhole and Gully Trap</td>
<td>Patel Pattern</td>
</tr>
<tr>
<td>51</td>
<td>Drip Seal</td>
<td>ACQUA Bond / Vinod Cement Co. Chandigarh</td>
</tr>
<tr>
<td>52</td>
<td>GI pipe sealent</td>
<td>Henkel - LOCTITE 55</td>
</tr>
<tr>
<td>53</td>
<td>Pipe clamp &amp; supports</td>
<td>Chilly / Euroclamp / Easyflex / Gripple</td>
</tr>
<tr>
<td>54</td>
<td>D. I. Pipes</td>
<td>Electro Steel / Jindal / Lanco Kalahasthi</td>
</tr>
<tr>
<td>55</td>
<td>Copper Pipes &amp; Fitting</td>
<td>Flowflex – Rajco / Viega – Max flow</td>
</tr>
<tr>
<td>56</td>
<td>UPVC Pipe</td>
<td>Astral / Finolex / Supreme</td>
</tr>
<tr>
<td>57</td>
<td>CPVC pipes</td>
<td>Ajay / Ashirwad / Astral</td>
</tr>
<tr>
<td>58</td>
<td>PB Pipe</td>
<td>Flexalen – Thermaflex / George Fisher</td>
</tr>
<tr>
<td>59</td>
<td>Solenoid Valve</td>
<td>Avcon / Danfoss</td>
</tr>
<tr>
<td>60</td>
<td>Thermostatic valve</td>
<td>Oventrop</td>
</tr>
<tr>
<td>61</td>
<td>Air Release Valve</td>
<td>Arco / CIM / Fouress OR / SKS</td>
</tr>
<tr>
<td>62</td>
<td>Ball Float Valve</td>
<td>Esseti / HBD / Zoloto</td>
</tr>
<tr>
<td>63</td>
<td>NRV – Ball type – Sewage application</td>
<td>Danfoss / Silverspark</td>
</tr>
<tr>
<td>64</td>
<td>Y Strainer CI</td>
<td>Emerald / Sant / SKS / Zoloto</td>
</tr>
<tr>
<td>65</td>
<td>Self-Priming Pumps</td>
<td>Johnson / Kirloskar</td>
</tr>
<tr>
<td>66</td>
<td>Drinking Water Cooler</td>
<td>Blue Star / Usha / Voltas</td>
</tr>
<tr>
<td>67</td>
<td>Anti-Vibration Mounting &amp; Flexible Connections</td>
<td>Cori / Dunlop / Flexionics / Kanwal Industrial Corporation / Resistoflex / VIMPA</td>
</tr>
<tr>
<td>68</td>
<td>Pressure Gauge</td>
<td>Emerald / Fiebig / H Guru / Wika</td>
</tr>
<tr>
<td>69</td>
<td>Water Meter (Mechanical Type)</td>
<td>Actaris / Kranti / Kent</td>
</tr>
<tr>
<td>70</td>
<td>Electronic Flow Meter</td>
<td>Krohne (Forbes Marshall) / Rockwin</td>
</tr>
<tr>
<td>71</td>
<td>Level Controller &amp; Indicator (Water)</td>
<td>Auto Pump / Cirrus Engineering / Elegant Controls / Technika / Techtrol</td>
</tr>
<tr>
<td>72</td>
<td>Paints</td>
<td>Asian Paints / Berger / ICI / Shalimar Paints</td>
</tr>
<tr>
<td>73</td>
<td>MH / Water Tank Plastic Steps</td>
<td>KGM / Patel / Pranali Industries</td>
</tr>
<tr>
<td>74</td>
<td>Fastner</td>
<td>Fisher / Hilti</td>
</tr>
<tr>
<td>75</td>
<td>Fire Sealant</td>
<td>Birla 3 M / Hilti / Promat / STI (USA)/ Fire master</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Details of Materials / Equipment</td>
<td>Manufacturer’s Name</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>76</td>
<td>Manhole (Prefabricated)</td>
<td>OK Play / Supreme</td>
</tr>
<tr>
<td>77</td>
<td>Temperature Sensor/ Gauge</td>
<td>Forbes Marshall / Danfoss / Wika</td>
</tr>
<tr>
<td>78</td>
<td>Kitchen Hot Zone Suppression System</td>
<td>Ansl (Tyco) / Amerex India</td>
</tr>
</tbody>
</table>

### C. Fire Fighting Work

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Approved Makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fire hydrant valves</td>
<td>New Age, Arihant, Bhogilal, Hiren Ind. Corp. or approved eq.</td>
</tr>
<tr>
<td>2</td>
<td>Stand post hydrant</td>
<td>Kejariwal, Orient, Durga, Kamla, Janta or app eq.</td>
</tr>
<tr>
<td>3</td>
<td>Sprinkler head Pumps &amp; Pump sets</td>
<td>Grinnel, Spray safe, Central, H.D or approved eq.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kirloskar, Mather &amp; Plitt, Becon, Crompton Greaves, Jyoti, Calama, shehara</td>
</tr>
<tr>
<td>4</td>
<td>Pipe coat material (pipe protection)</td>
<td>PYPECOAT</td>
</tr>
<tr>
<td>5</td>
<td>Fire Extinguishers</td>
<td>New Age, Arihant, Hiren, Safex, Firestone Ind. or approved eq.</td>
</tr>
<tr>
<td>6</td>
<td>Ductile iron pipes</td>
<td>Electro steel, Lanco, SAW or approved eq.</td>
</tr>
<tr>
<td>7</td>
<td>Ductile iron specials / fittings</td>
<td>Electro steel, Kejariwal, Kiswock, Truforms or approved eq.</td>
</tr>
<tr>
<td>8</td>
<td>Fire hose, First aid hose reel, Branch pipe, Siamese connections, Hose coupling, Nozzle, Sprinklers, Fire Brigade connection etc.</td>
<td>Firex, Minimax, Safex, New Age, Arihant, Bhogilal, Hiren or approved eq.</td>
</tr>
<tr>
<td>9</td>
<td>Fire / Sprinkler Main Pump / Jockey</td>
<td>Aurora / Armstrong / Grundfos / ITT (A-C Pumps)</td>
</tr>
<tr>
<td>10</td>
<td>GI / M.S Pipes (IS : 1239 and IS : 3589)</td>
<td>APL-Apollo / Jindal / Tata Steel / Surya / AST Pipes / Hitech / Swastik</td>
</tr>
<tr>
<td>11</td>
<td>Standard M.S. Fittings</td>
<td>Seamless Fittings / Pipeline Products</td>
</tr>
<tr>
<td>12</td>
<td>DI / CI / Forged Steel Fittings</td>
<td>Jainsons Industries / VS</td>
</tr>
<tr>
<td>13</td>
<td>DI Grooved Fitting &amp; Coupling</td>
<td>Tyco / Victaulic / Viking</td>
</tr>
<tr>
<td>14</td>
<td>C.I. Class LA Pipes</td>
<td>Electro Steel Calcutta / IISCO / NECO / Kesoram Calcutta</td>
</tr>
<tr>
<td>15</td>
<td>RCC Pipe</td>
<td>K K / Local &amp; Approved Pranali</td>
</tr>
<tr>
<td>16</td>
<td>D.I. Manhole Covers &amp; Frames</td>
<td>Kartar valves &amp; fittings / NECO / Raj Iron Foundry Agra</td>
</tr>
</tbody>
</table>
## Sr. No. | Details of Materials / Equipment | Manufacturer’s Name
--- | --- | ---
20 | Paints | Asian Paints / Berger / ICI / Shalimar Paints
21 | Double / Single Headed Landing Valve | New Age / Safeguard / Shah Bhogilal
22 | Fire Hose | CRC / Jayashree / Padmini / Safeguard / Safefire
23 | First Aid Hose Reel (LPCB Approved) | Monsher / Padmini / Safeguard / Safefire
24 | Gun Metal Brach Pipe | New Age / Safeguard
25 | Fireman Axe | New Age / Safeguard
26 | Installation Control Valve | HD / Newage / Tyco / Viking
27 | Sprinkler Heads | Tyco / Viking / Newage
28 | Flexible Drop Connection (UL Listed) | Flexhead / Newage / Tyco
29 | AFF Solutiona & Cscillating Nozzle | Ansul / Newage
30 | Electrical panel Detection & Suppression System | Avec India / Fire Trace
31 | Fire Extinguishers | Alert – Tyco / Minimax / Safefire / Safeguard
32 | Water Flow Switch | Honeywell Potter Rapid Control System Sensor Spray Safe
33 | Pipe Protection Wrapping | Rustech – Coatek
34 | Pipe clamp & supports | Chilly / Euroclamp / Easyflex / Gripple

### D. HVAC WORKS

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Details of Materials / Equipment</th>
<th>Manufacturer’s Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VRV UNITS</td>
<td>TOSHIBA / DAIKIN / MITSUBISHI</td>
</tr>
<tr>
<td></td>
<td>FANS / BLOWERS</td>
<td>KRUGER / NICOTRA / GREENHECK</td>
</tr>
<tr>
<td></td>
<td>COPPER PIPES</td>
<td>RAJCO / MANDEV</td>
</tr>
<tr>
<td></td>
<td>GSS SHEET</td>
<td>JINDAL / TATA</td>
</tr>
<tr>
<td></td>
<td>PRE FABRICATED DUCT</td>
<td>ROLASTAR / ALPHA DUCT</td>
</tr>
<tr>
<td></td>
<td>GRILLES &amp; DIFFUSERS</td>
<td>CARYAIRE / DYNACRAFT / COSMOS</td>
</tr>
<tr>
<td></td>
<td>VCD / OBD / BACK DRAFT DAMPER</td>
<td>CARYAIRE / DYNACRAFT / COSMOS</td>
</tr>
<tr>
<td></td>
<td>SMOKE &amp; FIRE DAMPER</td>
<td>RUSKIN / GREENHECK / CARYAIRE/KRUGER</td>
</tr>
</tbody>
</table>
Sr. No. | Details of Materials / Equipment | Manufacturer’s Name
--- | --- | ---
FIRE DAMPER ACTUATOR | BELIMO |
VFD | DANFOSS |
CONSTANT AIRFLOW REGULATOR | ALDES |
OPEN / CLOSE CELL NITRILE RUBBER | KFLEX / ARMACELL |
ELECTRICAL CABLES | POLYcab / CCI / FINOLEX |
ELECTRICAL PANEL COMPONENT | L&T, SIEMENS, ABB, SCHENIDER |
BMS | CICC (SIEMENS), JOHNSON CONTROLS, TRANE |

Note: Preference will be given to use maximum number of available components from any one of the selected manufacturer for the project.

Sr. No. | Details of Materials / Equipment | Manufacturer’s Name
--- | --- | ---
**FIRE ALARM SYSTEM**
1. Fire Alarm System and All Accessories | Bosch / Cooper / GE Edwards / Honeywell Morley / Siemens / Hochuki |
2. Public Address System and All Accessories | Bosch / Cooper / Honeywell |
3. Sealed maintenance free batteries | Exide / GS Batteries (Japan Storage Co Ltd.) / Hitachi |
4. Communication Cable - **Indigenous** | Finolex / Lappkabel / Polycab / RR Kabel |
5. Communication Cable - **Imported** | Belden / Comscope- USA / Southwest wire & Cable / Volex |
6. Personal Computer | Dell / Hewlet Packard / IBM / Wipro |
7. Color Monitor | LG / Philips / Samtron / Samsung |
### CEMENT CONSUMPTION COEFFICIENTS (Derived on the basis of CPWD AOR)

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Brief Description of Item</th>
<th>Unit</th>
<th>Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bags</td>
</tr>
<tr>
<td><strong>Part-I-SANITARY INSTALLATIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Fixing I.W.C. or European or pedestal type w.c. with flushing cistern and brackets, slush pipe with fittings and clamp including making good the walls and floors.</td>
<td>Each</td>
<td>5.0</td>
</tr>
<tr>
<td>2</td>
<td>Fixing 32 mm φ flush pipe</td>
<td>Each</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>Fixing w.c. pan only + a pair of foot rests.</td>
<td>Each</td>
<td>2.5+0.5</td>
</tr>
<tr>
<td>4</td>
<td>Fixing flat back or wall type, lipped front, urinal basin:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) One urinal with 5 litre cistern</td>
<td>Each</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>b) Two urinal with 10 litre cistern</td>
<td>Each</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>c) Three urinal with 10 litre cistern</td>
<td>Each</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>d) Four urinal with 15 litre cistern</td>
<td>Each</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>e) Urinal basin only</td>
<td>Each</td>
<td>1.0</td>
</tr>
<tr>
<td>5</td>
<td>Fixing stall urinals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Single stall urinal with 5 litre cistern</td>
<td>Each</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>b) Two stall urinal with 10 litre cistern</td>
<td>Each</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>c) Three stall urinal with 10 ltr. Cistern</td>
<td>Each</td>
<td>15.3</td>
</tr>
<tr>
<td></td>
<td>d) Four stall urinal with 15 ltr. cistern</td>
<td>Each</td>
<td>20.3</td>
</tr>
<tr>
<td></td>
<td>e) Stall urinal only</td>
<td>Each</td>
<td>2.0</td>
</tr>
<tr>
<td>6</td>
<td>Fixing lavatory basin/ sink with brackets &amp; making good the walls</td>
<td>Each</td>
<td>2.5</td>
</tr>
<tr>
<td>7</td>
<td>Fixing wash basin/ kitchen sink</td>
<td>Each</td>
<td>1.5</td>
</tr>
<tr>
<td>8</td>
<td>Fixing T.W. draining board with brackets and making good the walls</td>
<td>Each</td>
<td>1.4</td>
</tr>
<tr>
<td>9</td>
<td>Fixing M.S. holder bat clamp in C.C. 1:2:4 block/ M.S. stay and clamp for C.I. pipe</td>
<td>Each</td>
<td>0.5</td>
</tr>
<tr>
<td>10</td>
<td>Fixing S.C.I trap with grating including making good the walls and floors</td>
<td>Each</td>
<td>2.5</td>
</tr>
<tr>
<td>11</td>
<td>Cutting chase in B.W. for fixing S.C.I. pipe &amp; making good the B.W. in In C.M. 1:3</td>
<td>Each</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>a) 100 mm dia</td>
<td>Each</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Each</td>
<td>Unit</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>12</td>
<td>Fixing square mouth S.W. gully trap with C.I. grating and B.M. Chamber</td>
<td>23.0</td>
<td>0.46</td>
</tr>
<tr>
<td>13</td>
<td>Providing and fixing M.S. foot rests with 200 x 200 x 100 mm C.C. 1:3:6 block</td>
<td>0.88</td>
<td>0.018</td>
</tr>
<tr>
<td>14</td>
<td>Fixing C.I. Steps (Rungs)</td>
<td>1.0</td>
<td>0.02</td>
</tr>
<tr>
<td>Sr. No</td>
<td>Brief Description of Item</td>
<td>Unit</td>
<td>Cement</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>kg</td>
</tr>
<tr>
<td>1</td>
<td><strong>Part-II-WATER SUPPLY SYSTEM</strong></td>
<td></td>
<td>Bags</td>
</tr>
<tr>
<td></td>
<td>Constrn.of BM valve chambers 1.0 M depth, 230 mm thick b.m. in cm 1:4 over 150 mm thick CC 1:2:4 bed also for capping and bearing Course on the top of masonry wall, 150 mm offset cp in cm1:3 mixed With w.p.comp.@ 2% by wt. Of cement, 20 mm thick both on int.&amp; ext.surfaces, int. surfaces finished smooth with a floating coat of neat cement and ext.surfaces finished rough with wooden float, providing 100 mm thick RCC slab casted in G. M.S.angle box frame.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Chamber 1 M. x 1 M. clear int.dim. without s.b.</td>
<td>Each</td>
<td>493.00</td>
</tr>
<tr>
<td>b</td>
<td>Chamber 1 M. x 1 M. clear int.dim. with s.b.</td>
<td>Each</td>
<td>493.00</td>
</tr>
<tr>
<td>c</td>
<td>Extra depth for V.C.over item No: (a&amp;b).</td>
<td>RM</td>
<td>236.50</td>
</tr>
<tr>
<td>d</td>
<td>Chamber 1.2 M. x 1.2 M. clear int.dim. without s.b.</td>
<td>Each</td>
<td>592.00</td>
</tr>
<tr>
<td>e</td>
<td>Chamber 1.2 M. x 1.2 M. clear int.dim. with s.b.</td>
<td>Each</td>
<td>592.00</td>
</tr>
<tr>
<td>f</td>
<td>Extra depth for V.C.over item No: (d&amp;e).</td>
<td>RM</td>
<td>274.00</td>
</tr>
<tr>
<td>2</td>
<td>Prov.Valve chamber(suitable for C.I. Frame &amp; cover) of following int.dim., 230 mm thick b.m. in CM 1:4, over a 150 mm thick CC 1:4:8 bed with 150 mm offset from all finished faces also for capping and bearing course on the top of masonry wall, 15 mm thick c.p.in cm1:3 with w.p.comp.@ 2% by wt.of cement on int.&amp; ext.surfaces, all int.surfaces finished smooth with a floating coat of neat cement and ext.surfaces finished rough with wooden float.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Valve chamber of internal dimension 300x300 mm upto following depth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Valve chamber of 300mm depth.</td>
<td>Each</td>
<td>76.00</td>
</tr>
<tr>
<td>b</td>
<td>Valve chamber of 450mm depth.</td>
<td>Each</td>
<td>90.00</td>
</tr>
<tr>
<td>B</td>
<td>Valve chamber of internal dimension 450x450 mm upto following depth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Valve chamber of 300mm depth.</td>
<td>Each</td>
<td>98.50</td>
</tr>
<tr>
<td>b</td>
<td>Valve chamber of 450mm depth.</td>
<td>Each</td>
<td>116.00</td>
</tr>
<tr>
<td>c</td>
<td>Valve chamber of 600mm depth.</td>
<td>Each</td>
<td>133.50</td>
</tr>
<tr>
<td>C</td>
<td>Valve chamber of internal dimension 600x600 mm upto following depth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Valve chamber of 300mm depth.</td>
<td>Each</td>
<td>121.50</td>
</tr>
<tr>
<td>b</td>
<td>Valve chamber of 450mm depth.</td>
<td>Each</td>
<td>143.00</td>
</tr>
<tr>
<td>c</td>
<td>Valve chamber of 600mm depth.</td>
<td>Each</td>
<td>164.50</td>
</tr>
<tr>
<td>Sr. No</td>
<td>Brief Description of Item</td>
<td>Unit</td>
<td>Cement</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>kg</td>
</tr>
<tr>
<td>3</td>
<td>Prov. Valve chamber (suitable for SFRC cover) of following int. dim., 230 mm b.m. in CM 1:4, over a 150 mm th. CC 1:4:8 bed with 150 mm offset from all finished faces also for capping and bearing course on the top of masonry wall, 15 mm thick c.p. in cm 1:3 with w.p. comp. @ 2% by wt. of cement on int. &amp; ext. surfaces, all int. surfaces finished smooth with a floating coat of neat cement and ext. surfaces finished rough with wooden float, supplying &amp; placing SFRC cover.</td>
<td></td>
<td>Bags</td>
</tr>
<tr>
<td>A</td>
<td><strong>Valve chamber of internal dimension 300x300 mm upto following depth.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Valve chamber of 300mm depth.</td>
<td>Each</td>
<td>76.00</td>
</tr>
<tr>
<td>b</td>
<td>Valve chamber of 450mm depth.</td>
<td>Each</td>
<td>90.00</td>
</tr>
<tr>
<td>B</td>
<td><strong>Valve chamber of internal dimension 450x450 mm upto following depth.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Valve chamber of 300mm depth.</td>
<td>Each</td>
<td>98.50</td>
</tr>
<tr>
<td>b</td>
<td>Valve chamber of 450mm depth.</td>
<td>Each</td>
<td>116.00</td>
</tr>
<tr>
<td>c</td>
<td>Valve chamber of 600mm depth.</td>
<td>Each</td>
<td>133.50</td>
</tr>
<tr>
<td>C</td>
<td><strong>Valve chamber of internal dimension 600x600 mm upto following depth.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Valve chamber of 300mm depth.</td>
<td>Each</td>
<td>121.50</td>
</tr>
<tr>
<td>b</td>
<td>Valve chamber of 450mm depth.</td>
<td>Each</td>
<td>143.00</td>
</tr>
<tr>
<td>c</td>
<td>Valve chamber of 600mm depth.</td>
<td>Each</td>
<td>164.50</td>
</tr>
</tbody>
</table>
| 4     | **Fixing G.I. pipe on wall including making good the walls**  
(Note: 1 HaM = 100 M)                                                                                                                                                                                                                                                                     |      |        |
<p>| a)    | 15 mm φ                                                                                                                                                                                                                                                                                    | HaM  | 5.0    |
| b)    | 20 mm φ                                                                                                                                                                                                                                                                                    | HaM  | 6.0    |
| c)    | 25 mm φ                                                                                                                                                                                                                                                                                    | HaM  | 7.0    |
| d)    | 32 mm φ                                                                                                                                                                                                                                                                                    | HaM  | 7.5    |
| e)    | 40 mm φ                                                                                                                                                                                                                                                                                    | HaM  | 8.0    |
| f)    | 50 mm φ                                                                                                                                                                                                                                                                                    | HaM  | 8.0    |
| g)    | 80 mm φ                                                                                                                                                                                                                                                                                    | HaM  | 9.0    |
| h)    | 100 mm φ                                                                                                                                                                                                                                                                                    | HaM  | 10.0   |
| i)    | 150 mm φ                                                                                                                                                                                                                                                                                    | HaM  | 12.50  |</p>
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Brief Description of Item</th>
<th>Unit</th>
<th>Cement</th>
</tr>
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<tbody>
<tr>
<td></td>
<td><strong>Part-III-SEWERAGE SYSTEM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>Const. of rect. inspect. chambers of int. size 900 mm x 600 mm at bottom and int. size 900x450 mm at top for depth upto 600 mm &amp; brick masonry in cm 1:2, 230 mm th. wall incl. making brick tapering for log. walls for 450 mm depth meas. from top of frame &amp; cover, over 150 mm thick CC 1:2:4 with 150 mm offset from all outer fini. wall surfaces, also for benching, 20 mm th. c. p. in cm 1:1 with w. p. comp. @ 2% by wt. of cem. on int. &amp; ext. surfaces, int. surfaces and channel finished smooth with floating coat of neat cement and ext. surfaces finished rough with wooden float.</td>
<td>Each</td>
<td>312.50</td>
</tr>
<tr>
<td>1b</td>
<td>Extra over item 4(a) for depth beyond 600 mm initial depth upto a depth of 1500 mm. all as per specification and as directed.</td>
<td>RM</td>
<td>357.50</td>
</tr>
<tr>
<td>2a</td>
<td>Const. of circular manhole of 1200 mm int. dia. at bottom and 540/600 mm at top for 1500 mm ini. depth &amp; b. m. in cm 1:2, 230 mm th. wall for 1400 mm depth meas. from top of frame &amp; cover of M. H. in conical shape and remaining ht. Const. 345 mm th. in cyl. shape over a 300 mm th. CC 1:2:4 bed with 300 mm offset from outer finished wall surface, also for bench., 20 mm th. plaster in cm 1:1 with w. p. comp. @ 2% by wt. of cem. on int. &amp; ext. surfaces, int. surfaces and channel finished smooth with floating coat of neat cement and ext. surfaces finished rough with wooden float.</td>
<td>RM</td>
<td>1063.50</td>
</tr>
<tr>
<td>(i)</td>
<td>Top internal dia 540 mm to suit MD &amp; HD frame &amp; cover.</td>
<td>Each</td>
<td>1063.50</td>
</tr>
<tr>
<td>(ii)</td>
<td>Top internal dia 600 mm to suit EHD frame &amp; cover.</td>
<td>Each</td>
<td>1074.00</td>
</tr>
<tr>
<td>2b</td>
<td>Extra over item 5(a) for a depth beyond 1500 mm initial depth &amp; upto a depth of 2300 mm.</td>
<td>RM</td>
<td>534.00</td>
</tr>
<tr>
<td>3a</td>
<td>Const. of circular manhole of 1500 mm int. dia. at bottom and 540/600 mm at top for 2300 mm ini. depth &amp; b. m. in cm 1:2, 230 mm th. wall for 2000 mm depth meas. from top of frame &amp; cover of M. H. in conical shape and remaining ht. Const. 345 mm th. in cyl. shape over a 300 mm th. CC 1:2:4 bed with 300 mm offset from outer finished wall surface, also for bench., 20 mm th. plaster in cm 1:1 with w. p. comp. @ 2% by wt. of cem. on int. &amp; ext. surfaces, int. surfaces and channel finished smooth with floating coat of neat cement and ext. surfaces finished rough with wooden float.</td>
<td>RM</td>
<td>534.00</td>
</tr>
<tr>
<td>Sr. No</td>
<td>Brief Description of Item</td>
<td>Unit</td>
<td>Cement</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td>(i)</td>
<td>Top internal dia 540mm to suit MD &amp; HD frame &amp; cover.</td>
<td>Each</td>
<td>1685.50 33.71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>kg</td>
<td>Bags</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>Top internal dia 600mm to suit EHD frame &amp; cover.</td>
<td>Each</td>
<td>1702.00 34.04</td>
</tr>
<tr>
<td>3b</td>
<td>Extra over item 6(a) for a depth beyond 2300 mm initial depth.</td>
<td>Each</td>
<td>635.00 12.70</td>
</tr>
<tr>
<td>4</td>
<td>Constr.of b.m.drop pipe cleaning chamber of intl.size 300x300 mm for depth of 300 mm from top of cover &amp; frame above S.W. drop pipe in b.m., in c.m.1:2 and 230mm thk.wall over 150mm offset from all outer finished wall surfaces of the chamber, p.&amp; f. suitable MD precast SFRC cover 100 mm thk.CC 1:2:4 coping at top of b.m., 20mm cem.plastering in cm1:1, mixed with w.p.comp. @ 2% by wt.of cem.intl.&amp; extl.surfaces of the chamber, all inside surfaces finishing smooth with floating coat of neat cement and extl. Surfaces finishing rough with wooden float.</td>
<td>Each</td>
<td>138.50 2.77</td>
</tr>
<tr>
<td>5</td>
<td>P.&amp; f.drop connect for ini.depth of 600mm including p.&amp;l. following dia. S.W. pipe &amp; specials including p.&amp; f.bends, tees, crosses (double tees) plugs, caps etc., including jointing the joints with hemp yarn and C.M. 1:1, including encasing the pipes with CC 1:2:4 such that shape of the cross sect.through encased pipe shall be square of side length equal to o.d.of pipe plus 300mm.</td>
<td>Each</td>
<td>76.00 1.52</td>
</tr>
<tr>
<td>a)</td>
<td>150mm nom. dia.</td>
<td>Each</td>
<td>69.50 1.39</td>
</tr>
<tr>
<td>b)</td>
<td>Extra depth over item 8(a) beyond 0.60 M initial depth</td>
<td>RM</td>
<td>88.50 1.77</td>
</tr>
<tr>
<td>c)</td>
<td>230mm nom.dia.</td>
<td>Each</td>
<td>91.50 1.83</td>
</tr>
<tr>
<td>d)</td>
<td>Extra depth over item 8© beyond 0.60 M initial depth</td>
<td>RM</td>
<td>95.00 1.90</td>
</tr>
<tr>
<td>e)</td>
<td>300mm nom.dia.</td>
<td>Each</td>
<td>112.50 2.25</td>
</tr>
<tr>
<td>f)</td>
<td>Extra depth over item 8(e) beyond 0.60 M initial depth</td>
<td>RM</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>P.&amp; f,precast (SFRC) MH frame &amp; covers conf.to IS 12592 of following sizes approved by BMC/CIDCO/E-I-C, tested as per IS 1726 (Part-I)1974 incl.cost of necessary steel reinf.,CC1:2:4 for fixing frame, for bed block ( bearing course ) and capping including necessary form work and cm1:2 for fixing the frame &amp; for plast.exp.sof CC surf.of bed block ( b.c. ) &amp; capping fini. Smooth with floating coat of neat cement.</td>
<td>Each</td>
<td>1000 mm x 550 mm</td>
</tr>
<tr>
<td>a)</td>
<td>SFRC rect.frame for IC of size o/s 1130mm x 680mm, i/s clear opening 900mm, 450mm and RCC cover for IC of size 1000 mm x 550 mm</td>
<td>Each</td>
<td></td>
</tr>
</tbody>
</table>
### Technical Specification

#### Sr. No | Brief Description of Item | Unit | Cement
--- | --- | --- | ---
1 | i) Medium Duty (Grade MD-10) frame sect.size 110mm wide x105 mm deep and cover thick. 50mm | Each | 80.40 | 1.608

2 | ii) Heavy Duty (Grade HD-20) frame sect.size 115mm wide x150 mm deep and cover thick. 95mm | Each | 72.00 | 1.44

3 | b) SFRC circular frame & cover
   i) Medium Duty (Grade MD-10) SFRC frame of out. Dia. 840mm, clear intl.dia. 530mm, frame sect.size 155mm wide x115mm deep, SFRC manhole cover of 630mm dia. And 65 mm thick. | Each | 47.80 | 0.956

4 | ii) Heavy duty (Grade HD-20) SFRC frame of out.dia. 940mm, clear intl.dia. 540mm deep, frame sect.size 200 mm wide x150mm deep, SFRC manhole cover of 630mm dia. And 95 mm thickn. | Each | 32.70 | 0.654

5 | iii) Extra Heavy duty (Grade EHD-35) SFRC frame of out.dia. 940mm, clear intl.dia. 540mm dia. SFRC manhole cover of 780mm dia. And 120 mm thick. | Each | 30.00 | 0.60

6 | P & F air tight C.I. frame & cover of size and number as specified in schedule, for M.H. & I.C. each weighing ranging from 100 to 300 Kgs. Including cost of CC 1:2:4 for bed block (bearing course) and capping, fixing frame including necessary form work, 1:2 cement mortar for fixing frame and smooth cement finished plaster over exposed concrete surfaces of bed block (bearing course) and capping.
   a) C.I. rect. frame & cover for IC of int.size 900 x450mm
   i) Medium Duty (Grade MD-10) | Each | 89.35 | 1.787

   ii) Heavy Duty (Grade HD-20) | Each | 87.10 | 1.742

   b) SFRC circular frame & cover of in t. 560mm dia.
   i) Medium Duty (Grade MD-10) | Each | 48.75 | 0.975

   ii) Heavy Duty (Grade HD-20) | Each | 44.85 | 0.897

7 | P & F approved quality S.W. sewer trap of following sizes including placing the trap in position inside the manhole, embedding in C.C. 1:2:4, finishing the joints and rectifying the leakages.
   a) 100mm dia | Each | 6.50 | 0.13
### Sr. No | Brief Description of Item | Unit | Cement
--- | --- | --- | ---
|  |  | kg | Bags
| 1 | b) 150mm dia | Each | 11.00 | 0.22 |
| 2 | c) 200mm dia | Each | 16.50 | 0.33 |
| 3 | d) 230mm dia | Each | 19.50 | 0.39 |
| 4 | e) 250mm dia | Each | 24.00 | 0.48 |
| 5 | f) 300mm dia | Each | 31.00 | 0.62 |
| 9 | Making connections with the existing chamber or manhole including breaking the brick masonry wall re-doing the same to the original condition after the connection by adding approved w.p.comp. to the mortar. |  |  |  |
| 10 | a) 100mm dia | Each | 3.70 | 0.074 |
|  | b) 150mm dia | Each | 5.30 | 0.106 |
|  | c) 200mm dia | Each | 7.00 | 0.14 |
|  | d) 230mm dia | Each | 8.00 | 0.16 |
|  | e) 250mm dia | Each | 11.50 | 0.23 |
|  | f) 300mm dia | Each | 14.50 | 0.29 |
|  | g) 350mm dia | Each | 17.50 | 0.35 |
|  | h) 400mm dia | Each | 20.50 | 0.41 |
|  | i) 450mm dia | Each | 23.50 | 0.47 |

**NOTE FOR S.W. PIPES:**

1. To arrive the cement consumption of different proportion of cement mortar, consider 2/3 rd consumption for cm1:2 & 1/2 consumption for cm1:3 of the given consumption of cm 1:1

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>P &amp; L following dia.best quality s.g.S.W.pipe conf. IS 651-1980 with ISI mark and approved make, lowering and laying the pipe line in trenches for all depth including aligning &amp; jointing with hemp yarn and finishing with cm 1:1 mixed with w.p. comp, curing, testing the line.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) 100mm dia. ---------- 0.6m length</td>
<td>RM</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>b) 150mm dia. ---------- 0.6m length</td>
<td>RM</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>c) 200mm dia. ---------- 0.6m length</td>
<td>RM</td>
<td>4.35</td>
</tr>
<tr>
<td>Sr. No</td>
<td>Brief Description of Item</td>
<td>Unit</td>
<td>Cement kg</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------</td>
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<td>-----------</td>
</tr>
<tr>
<td>d)</td>
<td>230mm dia. ——— 0.6m length</td>
<td>RM</td>
<td>4.85</td>
</tr>
<tr>
<td>e)</td>
<td>250mm dia. ——— 0.6m length</td>
<td>RM</td>
<td>5.50</td>
</tr>
<tr>
<td>f)</td>
<td>300mm dia. ——— 0.6m length</td>
<td>RM</td>
<td>6.50</td>
</tr>
<tr>
<td>g)</td>
<td>350mm dia. ——— 0.6m length</td>
<td>RM</td>
<td>7.80</td>
</tr>
<tr>
<td>h)</td>
<td>400mm dia. ——— 0.6m length</td>
<td>RM</td>
<td>9.15</td>
</tr>
<tr>
<td>i)</td>
<td>450mm dia. ——— 0.6m length</td>
<td>RM</td>
<td>9.75</td>
</tr>
<tr>
<td>j)</td>
<td>500mm dia. ——— 0.6m length</td>
<td>RM</td>
<td>13.50</td>
</tr>
<tr>
<td>k)</td>
<td>600mm dia. ——— 0.6m length</td>
<td>RM</td>
<td>16.80</td>
</tr>
</tbody>
</table>

**NOTE FOR RCC / CC SPUN PIPES:**

1. To arrive the cement consumption of different proportion of cement mortar, consider 2/3 rd consumption for cm1:2 & 1/2 consumption for cm1:3 of the given consumption of cm 1:1

2. Pipes of 300mm dia.and above 3.0m,3.5m,4.0m in length may also be available except "NP1" class pipes.

3. The cement consumption for "P1" class pipe (which is available in the range of 80mm to 1200mm dia.) can be taken similar to "NP2" class pipe

11

Supplying, lowering, laying, CC class "NP1" spun pipes of following class conforming to IS-458 with necessary collars or spigot socket, laid to correct grade and levels at all depth, including cutting to lengths, jointing with rubber ring or with hemp yarn and cement mortar 1:1, caulking the joints, and finishing, curing, testing etc. complete as per specifications.

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Brief Description of Item</th>
<th>Unit</th>
<th>Cement kg</th>
<th>Bags</th>
</tr>
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<tbody>
<tr>
<td>a)</td>
<td>80mm dia. ——— 1.0m length</td>
<td>RM</td>
<td>0.62</td>
<td>0.012</td>
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<tr>
<td>b)</td>
<td>100mm dia. ——— 1.0m length</td>
<td>RM</td>
<td>0.71</td>
<td>0.014</td>
</tr>
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<td>c)</td>
<td>150mm dia. ——— 1.0m length</td>
<td>RM</td>
<td>0.86</td>
<td>0.017</td>
</tr>
<tr>
<td>d)</td>
<td>200mm dia. ——— 1.0m length</td>
<td>RM</td>
<td>1.06</td>
<td>0.021</td>
</tr>
<tr>
<td>e)</td>
<td>225mm dia. ——— 1.0m length</td>
<td>RM</td>
<td>1.17</td>
<td>0.023</td>
</tr>
<tr>
<td>f)</td>
<td>250mm dia. ——— 1.0m length</td>
<td>RM</td>
<td>1.26</td>
<td>0.025</td>
</tr>
<tr>
<td>Sr. No</td>
<td>Brief Description of Item</td>
<td>Unit</td>
<td>Cement</td>
<td></td>
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<td>-----------------------------------------------</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>kg</td>
<td>Bags</td>
</tr>
<tr>
<td>g)</td>
<td>300mm dia. 1.0m length</td>
<td>RM</td>
<td>1.96</td>
<td>0.039</td>
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<tr>
<td>h)</td>
<td>350mm dia. 1.0m length</td>
<td>RM</td>
<td>2.65</td>
<td>0.053</td>
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<tr>
<td>i)</td>
<td>400mm dia. 1.0m length</td>
<td>RM</td>
<td>3.34</td>
<td>0.067</td>
</tr>
<tr>
<td>j)</td>
<td>450mm dia. 1.0m length</td>
<td>RM</td>
<td>4.03</td>
<td>0.081</td>
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<td>Supplying, lowering, laying, RCC spun pipes</td>
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</tr>
<tr>
<td></td>
<td>of following class conforming to IS-458 with</td>
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</tr>
<tr>
<td></td>
<td>necessary collars or spigot socket, laid to</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>correct grade and levels at all depth,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>including cutting to lengths, jointing with</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>rubber ring or with hemp yarn and cement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>mortar 1:1, caulking the joints, and finishing,</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>curing, testing etc., complete as per</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>specifications.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>A</td>
<td>class - NP2 RCC</td>
<td></td>
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</tr>
<tr>
<td>a)</td>
<td>80mm dia. 2.0m length</td>
<td>RM</td>
<td>0.55</td>
<td>0.011</td>
</tr>
<tr>
<td>b)</td>
<td>100mm dia. 2.0m length</td>
<td>RM</td>
<td>0.75</td>
<td>0.015</td>
</tr>
<tr>
<td>c)</td>
<td>150mm dia. 2.0m length</td>
<td>RM</td>
<td>0.90</td>
<td>0.018</td>
</tr>
<tr>
<td>d)</td>
<td>200mm dia. 2.0m length</td>
<td>RM</td>
<td>1.15</td>
<td>0.023</td>
</tr>
<tr>
<td>e)</td>
<td>225mm dia. 2.0m length</td>
<td>RM</td>
<td>1.18</td>
<td>0.024</td>
</tr>
<tr>
<td>f)</td>
<td>250mm dia. 2.0m length</td>
<td>RM</td>
<td>1.35</td>
<td>0.027</td>
</tr>
<tr>
<td>g)</td>
<td>300mm dia. 2.5m length</td>
<td>RM</td>
<td>1.50</td>
<td>0.030</td>
</tr>
<tr>
<td>h)</td>
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<td>RM</td>
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</tr>
<tr>
<td>i)</td>
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<td>RM</td>
<td>2.80</td>
<td>0.056</td>
</tr>
<tr>
<td>j)</td>
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<td>RM</td>
<td>3.60</td>
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<td>3.90</td>
<td>0.078</td>
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<td>RM</td>
<td>4.80</td>
<td>0.096</td>
</tr>
<tr>
<td>Sr. No</td>
<td>Brief Description of Item</td>
<td>Unit</td>
<td>Cement</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------------</td>
<td>------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td>m)</td>
<td>700 mm dia.---------- 2.5m length</td>
<td>RM</td>
<td>5.55</td>
<td></td>
</tr>
<tr>
<td>n)</td>
<td>800 mm dia.---------- 2.5m length</td>
<td>RM</td>
<td>6.30</td>
<td></td>
</tr>
<tr>
<td>o)</td>
<td>900 mm dia.---------- 2.5m length</td>
<td>RM</td>
<td>7.35</td>
<td></td>
</tr>
<tr>
<td>p)</td>
<td>1000 mm dia.-------- 2.5m length</td>
<td>RM</td>
<td>8.25</td>
<td></td>
</tr>
<tr>
<td>q)</td>
<td>1100 mm dia.------- 2.5m length</td>
<td>RM</td>
<td>9.15</td>
<td></td>
</tr>
<tr>
<td>r)</td>
<td>1200 mm dia.------ 2.5m length</td>
<td>RM</td>
<td>10.20</td>
<td></td>
</tr>
<tr>
<td>s)</td>
<td>1400 mm dia.------- 2.5m length</td>
<td>RM</td>
<td>11.30</td>
<td></td>
</tr>
<tr>
<td>t)</td>
<td>1600 mm dia.------ 2.5m length</td>
<td>RM</td>
<td>12.80</td>
<td></td>
</tr>
<tr>
<td>u)</td>
<td>1800 mm dia.------ 2.5m length</td>
<td>RM</td>
<td>14.40</td>
<td></td>
</tr>
<tr>
<td>v)</td>
<td>2000 mm dia.------ 2.5m length</td>
<td>RM</td>
<td>16.00</td>
<td></td>
</tr>
<tr>
<td>w)</td>
<td>2200 mm dia.------ 2.5m length</td>
<td>RM</td>
<td>17.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>B class-NP3 RCC</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>a)</td>
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<td>RM</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>100 mm dia.------ 2.0 m Length</td>
<td>RM</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>150 mm dia.------ 2.0 m Length</td>
<td>RM</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>d)</td>
<td>200 mm dia.------ 2.0 m Length</td>
<td>RM</td>
<td>1.15</td>
<td></td>
</tr>
<tr>
<td>e)</td>
<td>225 mm dia.----- 2.0 m Length</td>
<td>RM</td>
<td>1.20</td>
<td></td>
</tr>
<tr>
<td>f)</td>
<td>250 mm dia.----- 2.0 m Length</td>
<td>RM</td>
<td>1.74</td>
<td></td>
</tr>
<tr>
<td>g)</td>
<td>300 mm dia.----- 2.5 m length</td>
<td>RM</td>
<td>1.74</td>
<td></td>
</tr>
<tr>
<td>h)</td>
<td>350 mm dia.----- 2.5 m length</td>
<td>RM</td>
<td>2.85</td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>400 mm dia.----- 2.5 m length</td>
<td>RM</td>
<td>3.80</td>
<td></td>
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<td>j)</td>
<td>450 mm dia.----- 2.5 m length</td>
<td>RM</td>
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<td></td>
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<tr>
<td>k)</td>
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<td>RM</td>
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<td>5.26</td>
<td></td>
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<tr>
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<td>Unit</td>
<td>Cement</td>
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<tr>
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<td>---------------------------------------------------------</td>
<td>-------</td>
<td>--------</td>
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<tr>
<td></td>
<td></td>
<td>kg</td>
<td>Bags</td>
<td></td>
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<tr>
<td>m)</td>
<td>700 mm dia.----------------- 2.5 m length</td>
<td>RM</td>
<td>5.95</td>
<td>0.119</td>
</tr>
<tr>
<td>n)</td>
<td>800 mm dia.----------------- 2.5 m length</td>
<td>RM</td>
<td>6.75</td>
<td>0.135</td>
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<td>o)</td>
<td>900 mm dia.----------------- 2.5 m length</td>
<td>RM</td>
<td>7.45</td>
<td>0.149</td>
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<td>0.187</td>
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<td>r)</td>
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<td>RM</td>
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<td>0.202</td>
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<td>s)</td>
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<td>RM</td>
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<td>0.234</td>
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<tr>
<td>t)</td>
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<td>0.264</td>
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<td>0.294</td>
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<td>y)</td>
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<td>C</td>
<td>Class-P2RCC</td>
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<td></td>
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<tr>
<td>a)</td>
<td>80 mm dia.----------------- 2.0 m Length</td>
<td>RM</td>
<td>0.55</td>
<td>0.0110</td>
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<tr>
<td>b)</td>
<td>100 mm dia.----------------- 2.0 m Length</td>
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<td>0.75</td>
<td>0.0150</td>
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<tr>
<td>c)</td>
<td>150 mm dia.----------------- 2.0 m Length</td>
<td>RM</td>
<td>0.90</td>
<td>0.0180</td>
</tr>
<tr>
<td>d)</td>
<td>200 mm dia.----------------- 2.0 m Length</td>
<td>RM</td>
<td>1.15</td>
<td>0.0230</td>
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<tr>
<td>e)</td>
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<td>RM</td>
<td>1.20</td>
<td>0.0240</td>
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<tr>
<td>f)</td>
<td>250 mm dia.----------------- 2.0 m Length</td>
<td>RM</td>
<td>1.74</td>
<td>0.0347</td>
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<tr>
<td>g)</td>
<td>300 mm dia.----------------- 2.5 m length</td>
<td>RM</td>
<td>1.74</td>
<td>0.0348</td>
</tr>
<tr>
<td>h)</td>
<td>350 mm dia.----------------- 2.5 m length</td>
<td>RM</td>
<td>2.44</td>
<td>0.0488</td>
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<tr>
<td>i)</td>
<td>400 mm dia.----------------- 2.5 m length</td>
<td>RM</td>
<td>3.15</td>
<td>0.0630</td>
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<tr>
<td>j)</td>
<td>450 mm dia.----------------- 2.5 m length</td>
<td>RM</td>
<td>3.85</td>
<td>0.0770</td>
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</tbody>
</table>
### Sr. No | Brief Description of Item | Unit | Cement
---|---|---|---
  k) 500 mm dia. 2.5 m length | RM | 4.37 | 0.0873
  l) 600 mm dia. 2.5 m length | RM | 5.39 | 0.1077
  m) 700 mm dia. 2.5 m length | RM | 5.95 | 0.1190
  n) 800 mm dia. 2.5 m length | RM | 6.78 | 0.1355
  o) 900 mm dia. 2.5 m length | RM | 7.63 | 0.1526
  p) 1000 mm dia. 2.5 m length | RM | 8.45 | 0.1689

#### Part-IV – STORM WATER DRAINS & CHAMBERS

1a. Construction of storm water chambers of internal sizes 600 mm x 600 mm x 600 mm initial depth, 450 thk. Wall in R.R. masonry in CM 1:6, 150 mm thick bedding in CC1:4:8, 50 mm thk benching, 80 mm high haunching in CC1:2:4, also for 100 mm thick capping & bearing course plastering in cm 1:4, 20 mm thick.

<p>| Each | 269.00 | 5.38 |</p>
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Unit</th>
<th>Rate</th>
<th>Amount</th>
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<tr>
<td>b</td>
<td>Extra over item (a) over 0.6 m initial depth.</td>
<td>RM</td>
<td>181</td>
<td>3.62</td>
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<tr>
<td>2a</td>
<td>Constn. of storm water chambers of internal sizes 600mm x 1050mm x 900mm initial depth, 450 thk. Wall up to 700mm depth from top of chamber &amp; remaining height 600mm thk. in R.R. masonry in CM 1:6, 150mm thick bedding in CC1:4:8, 50mm thk. Benching, 80mm high haunching, 100mm thick capping &amp; bearing course in CC1:2:4, plastering in cm 1:4:20mm thick on sides of drain, 12mm thick on top &amp; base in cm 1:4, finished smooth with neat cement, supplying and placing medium duty (MD) RCC precast perforated cover 750mm x 600mm x 75mm etc complete and as directed by engineer in charge.</td>
<td>Each</td>
<td>432.65</td>
<td>8.65</td>
</tr>
<tr>
<td>b</td>
<td>Extra over item (a) over 0.9 m initial depth.</td>
<td>RM</td>
<td>316.80</td>
<td>6.34</td>
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</table>
SCHEDULE OF TECHNICAL DATA

1. FIRE PROTECTION SYSTEM
1.1 FIRE PUMPS & MOTOR
1.1.1 Electrical Driven Main Fire & Sprinkler Pumps

Make / Manufacturer : 
Quantity : 
Liquid Handed : 
Liquid Temp deg.C : 
Special Gravity of Liquid : 
Suction : 
Rated Discharge at Low Zone Head : 
Rated Discharge at High Zone Head : 
Actual Discharge at Low Zone Head : 
Actual Discharge at High Zone Head : 
Model : 
Horizontal / Design : 
Speed / No. of Stages : 
Impeller Dia (Maximum) : 
Suction / Delivery Size : 
Efficiency at Rated Capacity & Head : 
KW required at rated capacity & head : 
Shut Off Head : 
Material of Construction

Pump Casing : 
Impeller :
<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Pump Shaft</td>
<td>:</td>
</tr>
<tr>
<td>Shaft Sleeve</td>
<td>:</td>
</tr>
<tr>
<td>Casing Wearing Ring</td>
<td>:</td>
</tr>
<tr>
<td>Base Plate</td>
<td>:</td>
</tr>
<tr>
<td>Mechanical Seal</td>
<td>Make of Mechanical Seal :</td>
</tr>
<tr>
<td>Wheather pumps is capable of discharging 150% of rated capacity at a head not less than 65% of rated head.</td>
<td>:</td>
</tr>
<tr>
<td>Whether automatic priming arrangement included</td>
<td>:</td>
</tr>
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</table>

**Description of Motors**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Make</td>
<td>:</td>
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<tr>
<td>Model No.</td>
<td>:</td>
</tr>
<tr>
<td>Type</td>
<td>:</td>
</tr>
<tr>
<td>Frame size</td>
<td>:</td>
</tr>
<tr>
<td>Speed (RPM)</td>
<td>:</td>
</tr>
<tr>
<td>Rated Capacity (Power)</td>
<td>:</td>
</tr>
<tr>
<td>Full load current</td>
<td>:</td>
</tr>
<tr>
<td>Enclosure</td>
<td>:</td>
</tr>
<tr>
<td>Coupling / Pulley</td>
<td>:</td>
</tr>
<tr>
<td>Class of Insulation</td>
<td>:</td>
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</tbody>
</table>

**Size of Foundation**

For complete coupled set mounted over MS base frame : 

**1.1.2 Diesel Engine Driven Pump**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
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</thead>
<tbody>
<tr>
<td>Make / Manufacturer</td>
<td>:</td>
</tr>
<tr>
<td>Quantity</td>
<td>:</td>
</tr>
</tbody>
</table>
Liquid Handed : 
Liquid Temp deg.C : 
Special Gravity of Liquid : 
Suction : 
Rated Discharge at Low Zone Head : 
Rated Discharge at High Zone Head : 
Actual Discharge at Low Zone Head : 
Actual Discharge at High Zone Head : 
Model : 
Horizontal / Design : 
Speed / No. of Stages : 
Impeller Dia (Maximum) : 
Suction / Delivery Size : 
Efficiency at Rated Capacity & Head : 
KW required at rated capacity & head : 
Shut Off Head : 

Material of Construction

Pump Casing : 
Impeller : 
Pump Shaft : 
Shaft Sleeve : 
Casing Wearing Ring : 
Base Plate : 
Mechanical Seal : 
Make of Mechanical Seal :
Wheather pumps is capable of discharging 150% of rated capacity at a head not less than 65% of rated head.

Whether automatic priming arrangement included:

**Description of Engine**

Make:

Model No.:

Type:

Frame size:

Speed (RPM):

Rated Capacity (Power):

Full load current:

Enclosure:

Coupling / Pulley:

No of Cylinder:

Fuel Pump & Water pump detail:

**Engine Cooling & Oil System**

Fuel Oil tank capacity:

Fuel Oil storage shall ensure working of pump for number of hours:

**Size of Foundation**

For complete coupled set mounted over MS base frame:

1.1.3 **Jockey Pump**

*Please submit separate data sheet for each type of pump*

Liquid Handed:

Liquid Temp deg.C:

Special Gravity of Liquid:
Suction : 
Rated Discharge at Low Zone Head : 
Rated Discharge at High Zone Head : 
Actual Discharge at Low Zone Head : 
Actual Discharge at High Zone Head : 
Model : 
Horizontal / Design : 
Speed / No. of Stages : 
Impeller Dia (Maximum) : 
Suction / Delivery Size : 
Efficiency at Rated Capacity & Head : 
KW required at rated capacity & head : 
Shut Off Head : 

Material of Construction
Pump Casing : 
Impeller : 
Pump Shaft : 
Shaft Sleeve : 
Casing Wearing Ring : 
Base Plate : 
Mechanical Seal : 
Make of Mechanical Seal : 

Description of Motor
Make : 
Model No. :
INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

EXTENSION OF CSRE BUILDING WITH LIGHT WEIGHT ROOFING SYSTEM FOR SINE INSIDE I.I.T.B CAMPUS

1.2. PIPING
15 NB TO 50 NB
15 TO 50 NB Fittings
65 NB TO 150 NB Pipes
65 NB TO 150 NB Fittings
200 NB ONWARDS Pipes
200 NB ONWARDS Fittings
Flanges
Gaskets

1.3. HYDRANT VALVES

1.3.1 Technical Specifications :

Item
Working Pressure
Code for Design Mft.

1.3.2 Construction Features

Type of Stem
Type of Inlet

Type of Outlet

Flange Drilling

1.3.3 Material of Construction

Body and Bonnet :

Stop Valve, Valve Seat :

Check nut & gland nut :

1.4 PRESSURE GAUGE

1.4.1 Technical Specifications :

Working Pressure :

Code for Design Mft. :

Scale range :

1.4.2 Construction Features

Case :

Pointer :

Dial Size :

Dial Lettering :

Process Connection :

1.4.3 Material of Construction

Case :

Movement :

Block :

1.5 PRESSURE SWITCHES

1.5.1 Technical Specifications :

Item :
15.2 Construction Features

Protection : 
Cable Entry : 
Process Connection : 
Repeatability : 

Switch
Type : 
No. of contacts : 
Contact Rating : 

15.3 Material of Construction

Enclosure : 
Pressure element : 
Wetted Parts : 

2. Electrical Accessories

2.1 Make of the following :
a. Motor Control Centre (Electrical Panel)
b. Vacuum circuit breaker
c. Air circuit breaker
d. MCCB
e. MCB
f. Rotary switch
g. Soft Starter
h. Auto-transformer Starter
j. Automatic Star Delta Starter
k. Direct on line Starter
l. Contactor
m. Current Transformer (cast resin type)
n. Single phase preventor
o. Push Button
p. Change over switch
q. Ammeter & Voltmeter
   KWH meter
r. Relay
s. Indication lamp
t. Cables
u. Wires
v. Variable Frequency Drive.

2.2. **ELECTRICAL TECHNICAL DATA SHEETS**

*For MCC +PDBs+MLDBs/SLDBs/DBs (To be filled by the bidders)*

<table>
<thead>
<tr>
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<th>Description</th>
<th>Recommended Specification</th>
<th>Confirmation by the Bidders</th>
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<tbody>
<tr>
<td>1</td>
<td>Type of Panel</td>
<td>a. MCC non drawout type compartmentalized.</td>
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<tr>
<td></td>
<td></td>
<td>b. Panels non drawout type, non compartmentalized</td>
<td></td>
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<tr>
<td>2</td>
<td>Type of Mounting</td>
<td>Free standing Floor Mounted</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Fault kA</td>
<td>50kA -1 Sec for MCC</td>
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</tr>
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<td>4</td>
<td>Thickness of CRCA sheets</td>
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</tr>
<tr>
<td>a</td>
<td>Structural members</td>
<td>3mm</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Covers and doors</td>
<td>2mm</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Base channel</td>
<td>MCC - ISMC 100</td>
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</tr>
<tr>
<td>d</td>
<td>Gland plate</td>
<td>3mm</td>
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</tr>
<tr>
<td>5a.</td>
<td>Painting/ Process</td>
<td>Synthetic Enamel Paint</td>
<td>As per seven tank process</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Oven baked.</td>
</tr>
<tr>
<td>b</td>
<td>Paint shade;</td>
<td></td>
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</tr>
<tr>
<td>a.</td>
<td>Inside</td>
<td>RAL – 7032</td>
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<tr>
<td>b.</td>
<td>Outside</td>
<td>RAL - 7032</td>
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</table>
6. Details of busbars
   Electrolytic grade Copper of specified rating for details see constructional features mentioned in specifications

7. Cable Entry
   For MCC & other Panels
   Top or Bottom depending upon location of Panel.

8. Enclosure
   For MCC – IP -52 with louvers for Ventilation.

9. Control Wiring/
    Power Wiring
   a. Voltage Circuit 1.5 sq mm
   b. Current Circuit 2.5 sq mm
   c. Minimum size of Power wiring CKt 16 sq mm

10. Maximum Operating Height 2100

11. Mounting height of Relays/Meters
    Range 350mm to 1900mm
    Control Switches

LIST OF MAIN DOCUMENTS AND SUBMITTALS

PLUMBING & FIREFIGHTING WORKS

<table>
<thead>
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<th>Items</th>
<th>Clause No.</th>
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<td>4- sets of Technical Literature</td>
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<td>3.</td>
<td>All Permits / Licenses</td>
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<tr>
<td>4.</td>
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<td>5.</td>
<td>Manufacturer’s Drawings, Catalogues &amp;</td>
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<td>Pamphlets &amp; Other Documents</td>
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<td>6.</td>
<td>Variation in Quantity Statement.</td>
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<td>7.</td>
<td>Electrical Installation Certificate.</td>
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<td>9.</td>
<td>Soft water &amp; Power Requirement</td>
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<td>10.</td>
<td>Appendix - IV</td>
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<td>11.</td>
<td>Testing, Adjusting and Balancing</td>
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Note: The above list is only for guide line of the contractor. The contractor shall thoroughly check all document and submittals required as per the tender document and submit them in time as per the requirement.